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"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH.

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Progress and Scientific Method

AMONG the misfortunes of this present age are the tendencies of the Press to seize on the sensational in the business of science, and of the public to expect such sensational pronouncements. This, equally with the absence of an adequate scientific element in our general educational system, of which the first is indeed a consequence, is mainly responsible for the general failure to understand the scientific spirit and the place of science in our civilisation.

Unquestionably, extravagant claims have been made alike regarding the contribution of science to general welfare and the part which men of science have to play in the State and in the general life of the community, and such claims have done great disservice to the cause of science. The evidence, however, does not indicate that in the main such claims have emanated from scientific workers themselves. They have more frequently been due to the journalistic quest for the sensational, to the quotation of impressive passages in the utterances of a man of science apart from the qualifying context. Of this danger the treatment recently accorded to a scholarly address by Prof. A. Findlay to a joint meeting of the Manchester chemical societies is a pertinent illustration. Under the headlines of "A Rebuke to Scientists" it is hard to recognise the thought-provoking address of Prof. Findlay with its wide sweep and philosophic temper, recalling at times the presidential address of General Smuts to the British Association in 1931. Prof. Findlay stressed the idealistic value of science rather than its

material results and suggested that the real claim of science to a wider recognition and cultivation in the community is based on such values. The spirit of science, as expressed in the quest for truth, is an essential element complementary to beauty and goodness in the perfecting of humanity, and its inculcation should form an essential element in our system of education.

This plea for science as an essential element of culture and not as part of a technical training was, however, ignored by those who fastened on his refutation of the claims of scientific workers to a privileged position in national administration. Unfortunately, Prof. Findlay himself made one or two incautious remarks which have tended to offset his admirable presentation of a point of view which scientific workers themselves have often been prone to overlook, owing to the widespread neglect of the teaching of the philosophy of science or the scientific outlook in the universities. Few scientific workers with any experience of industry would, for example, care to endorse the statement that, so far as industry is concerned, the battle for scientific control is already won. The position of the Cotton Industry Research Association in the very city in which the lecture was delivered should have been sufficient reminder of how very far we are yet from a general acceptance by industry of the importance of research as an essential element in industrial efficiency and advance. Similarly, so far as national administration is concerned, without pointing to a host of matters in which the neglect of technical factors and scientific opinion has been conspicuous, it is sufficient to recall that the report of the Bridgeman Committee on the Post Office issued recently was the first public inquiry committee to give full recognition to the scientific expert in the Civil Service scheme of things. Only in this report was it recognised officially that the scientific expert is entitled to participate on level terms with the administrative expert and the financial expert in the formulation of policy.

If the principle has been conceded, the application here and elsewhere has yet to be worked out, and those who most welcome Prof. Findlay's insistence on the cultural value of science will most regret his untoward suggestions regarding the capability of men of science for administrative work or the extent to which they have been accepted in such positions. While Prof. Findlay's protest against the mechanisation of industry and his warning against the dangers of materialism and an excessive emphasis on mechanical efficiency will be warmly welcomed, the influence of science on industry has scarcely been either so materialistic or so mechanising as he implies. On the contrary, the application of scientific methods of management characteristic of large-scale industry pays an attention to the human factor which was formerly rarely encountered. The results which have attended the investigations of the National Institute of Industrial Psychology or of the Industrial Health Research Board already attest the humanising effect which applied science can exert on industrial conditions. Moreover, the increasing attention which is being directed to the theory of management has already emphasised the importance to efficient administration of encouraging the development of individual responsibility, the expression of personality and the organisation of the team spirit.

It is indeed here that Prof. Findlay's address is most open to criticism. So far from human nature being intractable to the scientific method, the evidence suggests that one of the most urgent needs of to-day is an adequate attack on the social sciences and a determined attempt to place sociology, economics, psychology on a really scientific basis. Much patient research in anthropology and human biology will be required before this can be achieved, and it is highly probable that the most important contributions of science to human welfare during the next few decades will come from such fields as these, which enable us to understand and interpret more accurately the human factor and our social, economic and industrial problems.

Apart altogether from these considerations, Prof. Findlay's dislike for extravagance has led him to overlook the essential challenge presented by such spokesmen as Sir Alfred Ewing and Prof. Miles Walker. The failure of our present administrative methods to which our economic and international difficulties bear witness, and of which the bankruptcy of the Disarmament Conference is a recent example, had led many others besides men of science to wonder whether methods in which action is determined less by political prejudice than by dispassionate analysis of the ascertained facts may not offer better hope of success. The disposition to accept the leadership of science is prompted by a growing realisation of the extent to which scientific and technical factors enter into all our problems in this scientific age and that, if such factors are

only one aspect of our problems, they present an aspect which demands accurate assessment and intelligent action if disaster is to be avoided.

This point of view does not suggest that numerous other considerations are not involved in an administrative decision. It does, however, contend that the scientific worker who possesses administrative ability as well as the capacity to assess the technical facts is at least as likely to arrive at a sound decision, as those without such scientific knowledge and training, and that the openmindedness and willingness to face change associated with the scientific outlook is an important and hopeful element at the present time. The situation is so serious that accepted doctrines in finance, economics, politics are being questioned and must stand their trial as every scientific theory has to do in the advance of science.

Scientific management stands essentially for the substitution of exact scientific knowledge for opinions or rule of thumb methods, and not for the disregard of essential elements in a problem, whether those elements are or are not what is usually described as technical.

Even in industry, such exact scientific knowledge involves to an increasing extent a re-examination of the whole of our economic and indeed of our political machinery and ideas—a re-examination conducted much in the spirit of an engineer faced with a problem in factory or office management and concerned solely with the issue of improving those arrangements so as to secure a higher standard of living for the community. The world believes that the advancement of objective and exact knowledge is inevitable and ultimately beneficial and that the problems of distribution and finance, for example, so long treated in haphazard and fatalistic fashion, will yield to exact knowledge.

It can accordingly scarcely be questioned that in the modern State the scientific expert will occupy a position of increasing responsibility, and the security of our civilisation largely depends upon the efficiency and expedition with which methods are worked out for permitting his effective participation in public as in industrial affairs. Possibly the solution may be found along lines visualised by General Smuts, and the nations learn to look to the organised system of the expert report and accept as a matter of course, just as judicial decisions are accepted, the authoritative and impartial lead which it gives.

An important factor, however, is bound to be the general outlook of the scientific worker himself. His specialist knowledge of one particular field must be joined to a sense of values, a wide outlook and a public spirit which induce him to place his services to a greater extent at the disposal of society. In the leisure State there should be no room for the excessive specialisation and narrowness of outlook deplored by Prof. Findlay, and it should be possible so to re-organise our training that the cultural value of scientific thought and method is imparted to the student, and the tendency of scientific workers to regard only their special field from a scientific point of view counteracted. Only as scientific workers are prepared to regard the whole domain of life from a scientific point of view and to support as a body those who at particular points are seeking to extend the application of scientific method and the scientific spirit, substituting facts for prejudice, opinion or guesswork in determining action, can we hope for decisive advance. Both the organisation and the functioning of the State must become more scientific, impartial, business-like and less purely political, and the scientific expert is unlikely to receive his fitting place in the new order without organised support from his fellows as well as keen and intelligent criticism.

Prof. Findlay has done well to remind us that science is more than a body of results and truths. Great as are the benefits which mankind has derived from scientific discoveries, from the new knowledge which science has made available, there are greater services to be rendered. Science has yet to teach man how to use that knowledge, to impart generally that attitude, outlook or method of acquiring knowledge which is essential if mankind, individually or collectively, is to adapt himself to the new conditions. Science alone, indeed, will not save mankind from disaster, invaluable as can be its contribution to the fundamental thinking required. But the balanced wisdom and judgment so imperatively demanded to-day can only be attained as science is regarded not as a storehouse of facts to be consulted from time to time but as one of the great human endowments, to be ranked with art and religion, and the guide and expression of man's fearless quest for truth. This outlook can only receive adequate recognition as more and more in their own personality scientific workers exemplify the unifying power of the spirit of science and its contribution to the ordering of every sphere of conduct on a basis of truth and not prejudice.

Properties of the Atom

The Interpretation of the Atom. By Prof. Frederick Soddy. Pp. xviii+355+20 plates. (London: John Murray, 1932.) 21*s.* net.

FEW discoveries, if any, have influenced so rapidly and deeply physics, chemistry and many kindred sciences as that of the spontaneous disintegration of radioactive elements. The development following this discovery attracted also the lay mind, which was struck by the idea of evolution of inorganic matter and by the far-reaching conclusions in the field of geology and cosmology, to which the application of the science of radioactivity led. The layman's interest was enhanced by the spectacular sides like that of electroscopic discharge at the approach of the experimenter carrying radium in his pocket or suitcase, by the radium clock, and, by no means least, by the possibility of the medical application of radium rays against both tedious and fatal diseases.

The general reader interested in the great advances in our knowledge of the nature of matter and its manifold applications has every reason to be highly indebted to Prof. F. Soddy for his "Interpretation of Radium", first published in 1909. It is a most instructive task to compare the above mentioned book with "The Interpretation of the Atom", prepared by Prof. Soddy to take the place of the first mentioned volume, which has long been out of print. Even the reader familiar with atomic physics and chemistry will be struck when reading this account of the unparalleled progress made by these sciences in the last three decades. Part I deals fully and systematically with the remarkable series of spontaneous disintegration of the atom, while in Part II the general progress of atomic chemistry is discussed. A chapter on cognate geological and astronomical aspects and the cosmic radiation concludes the volume.

Prof. Soddy is known as a thinker and writer of unusual originality, who does not hesitate to oppose himself, even to ideas accepted by most of his contemporaries—a characteristic quality which, coupled with genius and lucidity, is undoubtedly responsible for his greatest achievement, the introduction of the conception of isotopes. The reader will therefore not be astonished to find Prof. Soddy in pronounced opposition to the mathematical presentation of physical theories in the age of great successes of quantum mechanics, and to learn that he is not among those who can "bow down and worship the square root of minus one". "The Interpretation of the Atom" is primarily intended for the general reader, but it will undoubtedly prove to be a helpful guide to scientific students of all grades; while the man of science interested in the history of this subject will also find matter of interest to him.

The development of scientific thought and progress often follows roundabout paths, which even the onlooker has difficulty in following; not a few scientific workers are inclined, therefore, to the view that the official history of the development of scientific thought not seldom differs materially from the actual course of events. Two examples may be cited, Bohr's fundamental conception of the atomic structure, and the development of the notion of atomic numbers, both outstanding events in natural philosophy, and the development of which are usually described in a way which differs materially from the actual facts. We mostly read that Bohr's conception was due to the effort to explain the appearance of spectral series. It would go too far to pretend that Bohr (who not long before passed his examination with first class honours) would not know of the existence of spectral series, but these were certainly not in the forefront of his thoughts when he first embarked on the philosophy of the atom. It was only at a later date, that in discussing experimental results obtained by one of his Copenhagen colleagues, he noticed the possibility of applying his new conception to explain the appearance of spectral series.

The actual development was as follows. Bohr was deeply struck by Rutherford's conception of the nuclear atom, realising simultaneously, however, the impossibility of reconciling this conception with the requirements of the classical theory of radiation. The most direct step would have been to discard Rutherford's conception; Bohr chose another path and introduced Planck's quantum idea in place of the classical conception, when interpreting the stability of the nuclear atom. By doing so he was led at once to the fundamental distinction between the nuclear and electronic properties of the atom, to the identity of the atomic number and nuclear charge and also to the conclusion that the emission of the disintegration β-particles has its origin in the nucleus. The latter led him to the conclusion

that, for example, when an atom of thorium loses consecutively one α- and two β-particles, the thorium atom reappears, and he arrived thus at the displacement laws, as a special case of a much wider generalisation. Bohr discussed this result widely without publishing it. These laws were, as is well known, published later by different men of science as an empirical summary of the experimental results of Fleck and others. That the sequence of the elements in their natural system, that is, the atomic number, is identical with the number of the nuclear charge, was published by Bohr at an early date when basing his first calculations on the assumption that the hydrogen nucleus has one, the helium nucleus two, elementary charges, and so on.

The above narrative of the introduction of the conception of the atomic number would, however, not be complete without mentioning that this conception emerged, simultaneously with Bohr's deductive line of thought, in the Manchester physics laboratory on inductive lines. Geiger and Marsden checked completely Rutherford's theory of large scattering of α-particles and found the nuclear charge of gold to be about 100. This result was not at all unexpected, as early theories of α-ray scattering and stopping had suggested already that there should be half as many electrons in the atom as its weight. When Moseley started his work which became the foundation of a new and important branch of physics, the conception of atomic number was thus clearly developed. We owe to Moseley's genius a simple method of determining the atomic number of each element and of fixing exactly the number of elements between hydrogen and uranium. From the fact that the nuclear charge of gold was found to be 100, and also from the chemical evidence, it followed already that the number of unknown elements could only be a very restricted one. The actual number was, however, fixed by Moseley.

The introduction of the conception of the atomic number impressed contemporary scientific workers so deeply that its rival conception, that of atomic mass, seemed for a while to be deposed from its long reign. Through Aston's work and the development of later years, contemporary interest is again focused on atomic mass and thus equal rights are secured for these two fundamental properties of the atom.

Every reader interested in the problems and the progress of natural science will find Prof. Soddy's book most fascinating reading. G. HEVESY.

Chromosome Mechanics

(1) *Recent Advances in Cytology.* By Dr. C. D. Darlington. Pp. xviii + 559 + 8 plates. (London: J. and A. Churchill, 1932.) 18*s.*

(2) *Chromosomes and Plant-breeding.* By Dr. C. D. Darlington. Pp. xiv + 112. (London: Macmillan and Co., Ltd., 1932.) 7*s.* 6*d.* net.

THE discovery that the chromosomes are the bearers of the hereditary units (genes) has led to a renewed interest in their study by cytological methods. There has developed a vast literature, much of it based on correlated studies of cytology and experimental genetics. Dr. Darlington has worked through this literature, and has attempted in the larger of the two works under notice not only to describe the more important recent results but also to provide a unified general scheme of chromosome behaviour.

This general scheme is based on several fundamental hypotheses. The first of these is that like chromosomes (or parts of chromosomes) are regularly attracted in pairs, and that the attractive force is satisfied when two like parts come together, so that more than two are not attracted. This leads directly to an interpretation of the difference between mitosis and meiosis. At mitosis each chromosome is already split into two daughter chromatids at prophase. These lie side by side and thus satisfy the attractive force. At meiosis the division is delayed, and attraction therefore causes homologous chromosomes to conjugate. Division now follows, and there result four chromatids instead of two chromosomes; these are no longer attracted except in pairs, and at each level there results a separation into two groups of two chromatids each. Observation shows, however, that this separation does not occur between the same pairs of strands at each level, so that there are chiasmata, or crossed strands, at certain points. Darlington argues that it is these chiasmata that maintain the unity of the quadruple structure until metaphase, and thus insure regular segregation. In the absence of chiasmata the chromosomes merely fall apart into two separate pairs, and these segregate at random at the first division.

According to Darlington, each chiasma results from a crossing over. The initial separation of two chromatids from two others is reductional at every level, that is, the two chromatids derived by division of a single chromosome always remain associated. If two that are not sisters have

undergone mutual exchange at a given level, there results a chiasma at that level.

These are Darlington's main theses; meiosis is mitosis with delayed division of the chromosomes, chiasmata result from crossing over, and metaphase pairing is due to chiasmata that prevent separation of divided homologues. He interprets the whole range of chromosome cytology and genetics on the basis of these views. There is a logical and detailed marshalling of an almost overwhelming body of evidence, much of it based on Darlington's own novel and extensive investigations. This evidence relates not only to careful analysis of the normal behaviour of a very wide variety of animals and plants, but also more especially to unusual cases —polyploids, extra-chromosome types, hybrids, and mutant differences in chromosome behaviour.

The reviewer finds himself strongly inclined in favour of two of the main hypotheses—those concerning the nature of meiosis and the effect of the chiasmata in holding homologues together until metaphase. The first of these is contrary to the observations of some cytologists, who have reported that the chromosomes divide before the meiotic conjugation; but Darlington's view has an attractive logical simplicity that makes it difficult to think of the phenomena in any other terms. Acceptance of these hypotheses involves also acceptance of the more fundamental hypothesis of attraction by twos and not by larger numbers. But it does not necessitate acceptance of Darlington's interpretation of the origin of chiasmata. This hypothesis leads to certain contradictions with the genetic data, which to the reviewer seem fatal to the hypothesis. The occurrence of regular pairing in the male *Drosophila*, in which there is no crossing over, makes it clear that chiasmata are not necessarily associated with crossing over—a conclusion avoided by Darlington only by the expedient of very special and improbable accessory hypotheses. It follows that chiasmata are not due to crossing over, and one may turn to the alternative view, referred to by Darlington as the "classical hypothesis". On this interpretation the initial separation is not always reductional, that is, at certain levels sister chromatids separate. If the separation is in different planes at successive levels, a chiasma will result between these levels. If the initial separations are permanent, crossing over will result (after, not before, the chiasma is formed), but it is possible that, at times, the original separation plane may be only temporary, the chiasmata simply unravelling without leading to crossing over. On such a basis it appears to be possible to give a self-consistent account of the genetic and cytological phenomena.

Evolutionary discussions occupy much space in Darlington's book. His view is that chromosomes are especially favourable for the construction of evolutionary schemes, because their materials control the gross structure of the organism but are not themselves controlled by the rest of the organism, and for several other reasons. The discussion of the evolution of chromosomes and chromosome systems is interesting and at times stimulating; but to one who has studied the period in the history of zoology when the making of hypothetical phylogenies was popular, there is a familiar sound to the argument. There are many who will hope that we are not to see a revival of the fashion of constructing elaborate hypothetical histories that must for ever remain hypothetical.

This is a difficult book. It is closely argued, and so full of facts and ideas as to require slow and careful reading. It will be indispensable for the student of cytology or genetics, but the more general reader will find the smaller book easier to assimilate. This, as its title indicates, is written for the plant breeder; but anyone interested in the new results obtained by the cytological study of polyploid and hybrid plants will find here an admirable and readable summary.

A. H. STURTEVANT.

Modern Physic

(1) *The British Pharmacopœia, 1932.* Published under the direction of the General Council of Medical Education and Registration of the United Kingdom. Pp. 1 + 713. (London: Published for the General Medical Council by Constable and Co., Ltd., 1932.) 18*s.* 6*d.* net.

(2) *The Extra Pharmacopœia of Martindale and Westcott.* Revised by Dr. W. Harrison Martindale. Twentieth edition. In 2 vols. Vol. 1. Pp. xlviii + 1216. (London: H. K. Lewis and Co., Ltd., 1932.) 27*s.* 6*d.* net.

(1) THE duty of preparing "The British Pharmacopœia" was laid upon the General Medical Council by the Medical Act of 1858 and the Medical Council Act of 1862. Since then five pharmacopœias have been issued at irregular intervals varying from three to eighteen years. The present issue is the sixth and in future

revision will take place every ten years. It is explained in the preface that the "Pharmacopœia" includes only the more important "standard articles, which are in use throughout the Empire" and with characteristic British elasticity in governance, provision is made for the issue of supplements or addenda by Governments of overseas parts of the Empire, who may desire to sanction the use of drugs with a local reputation. This is a happy solution of a long-standing difficulty.

The Commission upon which the actual work of preparing the "Pharmacopœia" devolved, was assisted in its labours by a group of sub-committees on clinical medicine, pharmacy, pharmacology, pharmacognosy and pharmaceutical chemistry, whilst the decision for or against biological standards for ergot, cod liver oil, digitalis and strophanthus, arsenobenzene derivatives and similar products, chemical control of which is still doubtful or impossible, necessitated the appointment of eight subsidiary committees, one for each subject of potential biological standardisation.

The revision of a pharmacopœia involves three branches of work, the elimination of drugs which have become redundant or obsolete, the selection of such recent contributions to *materia medica* as have found a sure footing in clinical medicine, and the definition of each item in the final list. In the new "Pharmacopœia" the omissions are far more numerous than the additions. They are chiefly galenical preparations, some of which are replaced by more modern examples of the pharmacist's art, some crude vegetable drugs, a number of compounded medicines and a few synthetic, pharmaceutical chemicals. No serious objection can be raised to any of these omissions, especially as the articles concerned will still figure in the British Pharmaceutical Codex, the revision of which is now in progress. Indeed this process of elimination might have been carried further. Eucalyptus oil (cineole, 70 or more per cent), cajuput oil (cineole, 50 to 60 per cent) and eucalyptol (cineole, 97·5 per cent) are presumably all included for the sake of their cineole content, this being the component indicated by the prescribed assay, and if so, two of them are redundant.

The additions include several well-known alkaloids, quinidine, ephedrine, ergotoxine and emetine, which have found new and important medicinal applications since 1914, a number of synthetic drugs, including a choice of local anæsthetics, and hypnotics and the indispensable antisyphilitics, neoarsphenamine and sulpharsphenamine. The most notable addition is the group of biological products including insulin, liver extract, Schick control, Schick test toxin, diphtheria prophylactic, antityphoid-paratyphoid vaccine, gas-gangrene antitoxin, and antidysentery serum. Apart from this biological innovation, it cannot be said that any striking change has been made in the list of officially recognised drugs. Some notable candidates for recognition have probably been omitted because they are patented products, others because their present reputation may be based on pioneering enthusiasm and they have still to run the gauntlet of extended clinical trial, which will eventually bring them to their proper places in practical therapeutics.

The list of official drugs, which emerges by the operation of these two kinds of selection, is essentially a matter for comment by clinicians, but if a chemist may venture two opinions upon it they are, that the list is what a list of officially-recognised drugs should be—safe, sound, and not too conservative—and that it is satisfactory because due weight has been given to the pharmacological and chemical evidence for and against each drug.

It is in the third branch of its labours, the definition of the selected products, that the Commission has most clearly improved upon preceding pharmacopœias. Much more attention is given to tests for identity and for degree of purity, to the analysis of chemicals and to the assay of potent galenical and biological preparations. In the 1914 Pharmacopœia the appendices amounted to over eighty pages: in the new issue nearly twice that space is occupied, due mainly to the inclusion of more descriptions of biological, chemical and physical methods for the determination of the quality of drugs, using that term in a broad sense. These appendices now form a useful and interesting manual of methods of assay, which may even find a place for the Pharmacopœia in laboratories not directly concerned with medicinal products.

Daily use of the sixth "British Pharmacopœia" will inevitably reveal minor weaknesses, but taken as a whole it is a satisfactory and in many ways a model contribution to the world's collection of national pharmacopœias. The nation has every reason to be grateful for the labours of the Pharmacopœia Commission, for the time and knowledge which the committees of experts have

expended and for the accumulated results of technical experience which manufacturers have given just as freely. The least it can do in return is to provide for that continuity of investigation which will lighten the work of preparing the Pharmacopœias of the future.

(2) When a technical work has reached its twentieth edition in the course of less than half a century, it may be assumed that the author knows much better than any merely ephemeral reviewer, what his particular public requires and in what form to give it to them. This is the case of the "Extra Pharmacopœia". The book is fittingly noticed here because it provides the medical practitioner with the information he needs about the latest developments in therapeutics and thus facilitates that extensive clinical experimentation with new *materia medica*, the results of which alone can finally determine their real value. It thus serves the cause of medical progress and at the same time admirably fulfils its main purpose as a handy and singularly complete reference book for the multifarious needs of the pharmacist and the medical man. In these respects the twentieth edition is as good and as up to date as its predecessors were in their day, and those who know the "Extra Pharmacopœia" need no further commendation. T. A. H.

Short Reviews

The Outline Series. *The Physical Nature of the Universe.* By J. W. N. Sullivan. Pp. 143. *Theories and Forms of Political Organisation.* By G. D. H. Cole. Pp. 160. *Modern Theories and Forms of Industrial Organisation.* By G. D. H. Cole. Pp. 159. *An Introduction to the Study of Sex.* By Prof. F. A. E. Crew. Pp. 160. *An Introduction to Psychology.* By Prof. F. Aveling. Pp. 176. *An Introduction to Finance.* By Prof. T. E. Gregory. Pp. 144. *An Introduction to Economics.* By Maurice Dobb. Pp. 143. *The Arts of Painting and Sculpture.* By Roger Fry. Pp. 160. *An Introduction to Psycho-Analysis.* By Prof. J. C. Flügel. Pp. 159. *The Theory and Practice of Architecture.* By Prof. C. H. Reilly. Pp. 144. *Principles of Literary Criticism.* By Prof. Lascelles Abercrombie. Pp. 160. (London: Victor Gollancz, Ltd., 1932.) 1*s.* 6*d.* each.

ONE of the more hopeful signs, indicating the approach of an age in which knowledge and power are more closely and harmoniously related, is the reception afforded to the various summaries or outlines of modern knowledge which have appeared in recent years. The publication in separate parts of eleven of the essays by acknowledged authorities which formerly appeared as a composite book under the title "An Outline of Modern Knowledge" is evidence of this demand and the publishers are to be congratulated on the step they have taken in place of issuing a new edition of the composite work.

The publication as individual essays is free from several objections which may be brought against the combined treatise. The essays can be seen as the introductory monographs which they really are and the impression of a reference book is destroyed. The lack of proportion in the original book is less conspicuous in the separated monographs and could indeed easily be remedied by the publication of supplementary volumes to fill the more serious gaps, so far as they are not found in the reprinted monographs themselves.

Handbuch der Pflanzenanalyse. Herausgegeben von G. Klein. Band 2: *Spezielle Analyse.* Teil 1: *Anorganische Stoffe; Organische Stoffe, I.* Pp. xi + 973. (Wien: Julius Springer, 1932.) 99 gold marks.

A KNOWLEDGE of the constituents of plants is becoming both of increasing importance and difficulty, as their number continues to grow, and it is, therefore, of value to have a work of reference which, on one hand, lists the various products according to some logical scheme, whilst on the other, it describes the methods for their identification and analysis. Working in conjunction with the index of nearly ninety pages, it is possible rapidly to have the requisite information about any desired compound.

The book is necessarily the result of collaboration, no less than twenty-three different authorities being responsible for the several sections. The first quarter of it deals with the inorganic constituents of plants including the nitrogen compounds, also the analysis of plant ash and gas: it is done with great attention to detail but in a suitably concentrated form. There follows the organic section divided up into groups of allied substances as is customary: it is this part which will be found of immense value to all active workers in the domain of plant chemistry.

The matter is highly condensed but contains just the information which is usually needed, and the text is not overburdened with countless references to the original literature, which the seeker must find in certain other works indicated, should he require them. Taking the section headed "Phenols" for example: the systematic occurrence in indicated plants is given for 61 phenols, 10 quinones, 11 anthraquinones. The general properties and colour reactions of phenols are described with a note as to the properties and derivatives of each individual phenol, the whole giving the complete state of knowledge in this particular field, which it would otherwise take a great deal of reading to survey.

Climate: a Handbook for Business Men, Students and Travellers. By Dr. C. E. P. Brooks. Second edition, revised. Pp. 199. (London: Ernest Benn, Ltd., 1932.) 10*s.* 6*d.* net.

AN early second edition testifies to the general utility of Dr. Brooks's handbook. All parts of the globe are dealt with, and a useful feature at the end of each regional division is a table furnishing for a number of selected places data of temperature, humidity, rain, snow and thunder. There are very few illustrations, and, perhaps, it is a recommendation that the book is not encumbered by a lot of commonplace maps and diagrams.

The treatment is essentially statistical, but Dr. Brooks knows his subject too well to allow his outlook to be blinded by the data which he wields. This is an important matter because climatology as a science has suffered badly from the mishandling or misinterpretation of the very data on which it largely depends.

The book is, however, not so free from loose statements as is to be expected in a second edition. For example, a statement, to the effect that it is the relative humidity which gives the 'feel' of the air, seems to us to be faulty. The 'feel' of the atmosphere is an intricate complex of temperature, wind, radiation, moisture and probably, also, obscure influences like electricity; but, so far as humidity is concerned, it is surely the absolute humidity or vapour pressure as controlling the rate of evaporation from the body which is the important factor, not the relative humidity except at saturation point with fog. Thus on an enervating summer day of high vapour pressure the relative humidity is often much lower than on a bracing winter day of low vapour pressure. L. C. W. B.

Faith, Hope and Charity in Primitive Religion. By R. R. Marett. Pp. vii+181. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 10*s.* net.

DR. MARETT'S Gifford lectures for 1931–32, an expanded form of lectures delivered under the auspices of the Lowell Institute of Boston in the previous year, have as their theme the evaluation of the religious experiences of peoples of the lower culture, or as Dr. Marett prefers to call them, savages. It must not be thought, however, that Dr. Marett would regard anthropology as one of the normative sciences and that he would attempt to apply an ethical scale to primitive ideas of behaviour. His evaluation is biological in the sense that its aim is to test survival value. The various activities of the savage are passed in review one by one and analysed with the view of the isolation of their emotional content—savage religion being a matter of the emotions rather than of intellect or of action. Dr. Marett then proceeds to show that the religious emotions which colour the whole range of savage activity on the whole make for the virtues or qualities which he designates "Faith, Hope and Charity" and regards as the effective element in the contribution of religion to the advancement and survival of man. A brief summary does less than justice to the acuity of Dr. Marett's vision—it may be suspected that at times he finds his material a thought intractable. Nor is it possible to do more than refer to the insight shown in the many valuable suggestions on controversial points which he throws off, almost casually, in the course of his argument.

Thermionic Vacuum Tubes and their Applications. By Prof. E. V. Appleton. (Methuen's Monographs on Physical Subjects.) Pp. vii+117. (London: Methuen and Co., Ltd., 1932.) 3*s.* net.

THE student with a good knowledge of general physics will find this volume very helpful in studying radio-frequency phenomena. Modern thermionic tubes have so many important applications in physics and electrical communication that a knowledge of their action and how they are constructed is essential to almost every research physicist and electrical engineer. The author writes carefully and clearly, so the ordinary reader easily grasps the laws which govern the emission of electricity from hot bodies and how to apply Richardson's formulæ to make calculations. He then explains the internal action of the two electrode tube (diode) and states some of its applications. Finally he discusses the three electrode tube (triode) and describes its applications as an amplifier, a rectifier and an oscillation generator. The book can be recommended to the experienced amateur in radio communication as a scientific introduction to the subject as well as to the physicist and mathematician who intend to read the relevant parts of advanced treatises well before following up some line of research.

The Practical Treatment of Diabetes. By Dr. T. Izod Bennett. Pp. ix+107. (London: Constable and Co., Ltd., 1931.) 6*s.* net.

THIS book is a brief and severely practical account of the modern method of treating the diabetic. References to theory are few and are limited to such details as are absolutely necessary to explain the therapeutic steps. A short chapter is devoted to diagnosis, the second and third to general principles of treatment and dieting, the fourth to the use of insulin, and the remainder of the book to complications and special problems and considerations. As described by Dr. Izod Bennett, the restoration of a diabetic to such condition that he is sugar-free on sufficient diet appears an easy matter, and the general practitioner who has not had to deal with many cases will learn with surprise that this object can be attained almost invariably within three weeks. How it can be done is clearly set out in some fifty pages of this book, which, as a practical guide, lacks no essential features. Specimen diets during treatment, and food tables showing the great variety finally available, are included.

Mount Everest

By Col. H. L. CROSTHWAIT, C.I.E.

MOUNT EVEREST, everyone knows, is the highest mountain in the world. It was discovered, and its height determined, during the operations of the Great Trigonometrical Survey of India in the course of carrying out the geodetic triangulation of that country in the years 1849–50. The figure adopted, namely, 29,002 ft. above mean sea level, was derived from the mean of a large number of vertical angles observed to the peak from six different stations situated in the plains of India south of Nepal. These stations were at distances varying from 108 to 118 miles. It was not until some months afterwards, when the necessary computations had been completed, that the great height of Everest was first realised. The actual discovery was made in the computing office at Dehra Dun.

The determination of height above mean sea level by the method of vertical angles, observed from one station only, involves the assumption of a coefficient of refraction—always a doubtful quantity, especially where great differences of height are concerned as in the present case—and also a knowledge of the amount of separation of the geoid and the sphereoid. Suffice it to say, however, that the subsequent extension of observations to the mountain so as to include stations situated within the hills, and the adoption of a more probable coefficient of refraction, made the summit some 29,149 ft., but the estimated separation of the geoid and sphereoid, due to deformation caused by local attraction, would reduce this amount, the net result being to assign to the peak a probable height of about 29,050 ft. above mean sea level. There are also certain other corrections which can be estimated theoretically but these are not taken into account in ordinary trigonometrical levelling.

By height above mean sea level is implied the distance of the summit above the geoid immediately beneath it. Accepting this definition, it is not possible to determine accurately the height when access cannot be had to the summit for purposes of observation. Taking into account that there are still doubtful quantities involved, it has been considered best to allow the time honoured figure of 29,002 ft. to stand, anyhow until sufficient data are available to enable a more exact solution of the problem.

It may be asked why so little was known about the highest mountain in the world beyond its position and height, until comparatively recently, considering it was discovered eighty-two years ago. This was, without doubt, due to its great distance from civilisation and above all to the strict political isolation maintained by the two countries, Nepal and Tibet, on the border of which it is situated. The shortest way, some 110 miles, to reach the mountain from India would be through Nepal, but even if the Nepalese Government were willing to permit the passage of its country, the route would be through trackless leach-infested jungles impossible for pack transport. Added to this, the snow line is about 2,000 ft. lower on the south side than on the north, for it is subject to the full force of the monsoon and is probably more deeply eroded and, in consequence, more inaccessible than from the Tibet side. For these reasons successive expeditions have taken the longer route, about 350 miles from Darjeeling via the Chumbi valley, Kampa Dzong and Sheka Dzong, made possible since the Tibetan objection to traversing its territory has been overcome.

This route possessed the advantage of passing through country where pack transport was available, and could be used up to the base camp. Further, it lies at an average elevation of about 14,500 ft., so the long march has a certain beneficial effect in acclimatising the party before the base of operations is reached.

Though the project to climb Mount Everest had been long in the minds of several mountaineers, the first definite move in the matter appears to have been due to Major Rawling and Captain Noel, about the year 1912–13. Both these officers had had experience of Tibetan travel. Then followed the years of the War in which Rawling was killed. The project was revived in 1920, when permission was obtained from the Tibetan Government to approach the mountain through its country. A Committee, consisting of three members each of the Royal Geographical Society and the Alpine Club, was formed to collect funds, select personnel, purchase instruments and equipment and generally to manage the business of an expedition to Everest. The chairman of this Committee was Sir Francis Younghusband.

There have now been three expeditions including the one in 1921, which was of the nature of a reconnaissance. The other two were serious attempts to reach the summit—they were undertaken in the years 1922 and 1924. As already announced, a fourth expedition will leave England early this year.

The expedition of 1921, led by Col. C. K. Howard-Bury, consisted of Dr. A. M. Kellas, C. Raeburn, G. H. L. Mallory, G. H. Bullock, mountaineers, and A. F. R. Wollaston, doctor and naturalist. Since the local topography of the mountain and its neighbourhood was quite unknown, Majors Morshead and Wheeler, of the Survey of India, with three Indian surveyors, and Dr. Heron, of the Indian Geological Survey, joined the expedition in India. Unfortunately, that veteran mountaineer, Dr. Kellas, died at Kampa Dzong on the way out.

The party started from Darjeeling on May 18 and after the long detour through Tibet, already mentioned, reached Tingri, a place about 45 miles north-north-west of Everest, a month later. On June 23, Mallory and Bullock began the exploration of the western and northern sections of Everest. Approach was soon found to be, if not impossible at least very difficult, from the west and north-west. They then turned their attention to the great Rongbuk Glacier which drains the northern slopes of the mountain. It was seen to consist of at least two important branches—one trending away to the west, and the main glacier coming down from the northern face of Everest itself.

As the result of these explorations the following facts were established, that the key of the mountain appeared to be an important saddle, the Chang La (North Col), 22,990 ft., situated at the head of the main Rongbuk Glacier, about $1\frac{3}{4}$ miles from the summit of Everest, and that it could only be reached with the greatest difficulty from the main glacier. It then became necessary to seek another way of approach to the Chang La. They decided to try what could be done from an easterly direction. They therefore marched round to a new base which, in the meantime, Howard-Bury had established in the Kharta Valley, at the head of which lies the Hlakpa La (22,200 ft.). This point they eventually reached in the face of very adverse weather. It was found to lead to a hitherto unsuspected eastern branch of the Rongbuk glacier, draining into the main valley through a narrow gorge, which had been missed during the first reconnaissance. Mallory, Bullock and Wheeler crossed the East Rongbuk glacier and succeeded in reaching the summit of the Chang La itself on September 24. In doing this they had the most difficult climb, especially for laden men, that had so far been encountered. "Beyond the Col (Chang La) an easy succession of rock and snow slopes could be seen leading to the north-east shoulder (27,390) of Everest."

The weather and the exhaustion of the party prevented any further advance. This closed the season of 1921. The results may be briefly stated. A practical route had been discovered, via the Chang La, which had been reached from the Kharta valley, but there was an easier way by the East Rongbuk glacier which avoided the ascent of the Hlakpa La and consequent descent of about 1,200 ft. in order to reach the foot of the Chang La. The best time for high climbing appeared to be the months of May and early June.

FIG. 1.—Everest and the surrounding country. By courtesy of the Royal Geographical Society

In the course of this reconnaissance, 600 square miles in the immediate neighbourhood of Mt. Everest were mapped photographically on the 1-inch scale, which proved of great use in subsequent expeditions.

A way had now been found to make a real attempt to reach the summit. The expedition of 1922 comprised Brig. Gen. the Hon. C. G. Bruce, as leader, Col. E. L. Strutt, as second-in-command,

Mallory, T. H. Somervell, Dr. T. H. Wakefield, Prof. G. I. Finch, Major (now Brigadier) E. F. Norton, mountaineers, Dr. T. G. Longstaff, doctor and naturalist, J. B. L. Noel, photographic and cinema expert. In India the party was joined by the late Lieut.-Col. H. T. Morshead, C. G. Crawford, Capts. Morris and G. Bruce.

One of the questions which the Mount Everest Committee had to consider was the use of oxygen for climbing the last stages of the mountain, which appeared to offer no great difficulty apart from lack of oxygen inseparable from great altitude. It is a matter on which climbers and physiologists are not agreed. Some are in favour of relying on the acclimatisation of those men selected for the final assault. This means remaining for some time at high altitudes under what, at best, must be very trying conditions, where deterioration may set in from the lack of well cooked food and exposure to great cold. The disadvantages of oxygen were the considerable weight of the apparatus, about 30 lb., which the climber himself would have to carry, and the number of porters required to take up the supply of spare cylinders in which the gas is compressed to 120 atmospheres. Then there was the danger of the apparatus going wrong at the critical moment. After taking into consideration all the arguments for and against, "the Committee finally unanimously agreed" to its use.

Profiting by the experience of the previous year, the expedition left Darjeeling on March 26, 1922, following the same route as the year before to Sheka Dzong where they turned south, reaching the spot selected for the Base Camp at the snout of the Rongbuk glacier, 16,560 ft., at the end of April. By May 20 camps were established up to Camp IV as shown on the accompanying sketch map. Camp III at a height of 21,000 ft. at the foot of Chang La on rock, Camp IV on the Chang La, on snow, just under 23,000 ft. What they had now "to aim at was getting two tiny tents carried up the North Face to some niche near the North-East Ridge at a height of 27,000 ft.", that is somewhere above the position of Camp VI on the map, and 2,000 ft. from the top. From such a point it was hoped the final assault on the summit could be successfully made. "So the crux of the situation was the capacity of porters to carry two tents and sleeping bags, provisions and light cooking apparatus for this 27,000 ft. camp" sufficient for four climbers. This arduous work was to be carried out by a specially selected corps of forty Nepalese porters.

The first assault was made on the morning of May 20 from Camp IV, where four climbers—Mallory, Somervell, Norton and Morshead—had slept the night before, but they were only able to reach Camp V, 25,000 ft., and had to spend the night there. The next day was fine and they succeeded in reaching a height of 26,985 ft. just below the north-east shoulder of Everest (marked 27,390 ft. on the map). They were "within one mile of the summit and there appeared to be no serious obstacle in this last remaining lap—only it was more than could be accomplished in one day from a camp at 25,000 ft." They were compelled to turn back on account of the slow progress made and the lateness of the hour. It was between 10 and 11 P.M. before the party reached the shelter of Camp IV on the Chang La. All four were more or less frost bitten during the descent. The worst case was Morshead, who afterwards had to have the top joint of three of his fingers amputated.

Finch, G. Bruce, and the Gurkha Lance-Corporal Tejbir, then made another attempt, this time using oxygen. They were accompanied from Camp IV by twelve porters carrying spare oxygen cylinders and camp gear. The climbers themselves carried the oxygen apparatus weighing about 30 lb. They hoped to pitch a camp at 26,000 ft., but they only succeeded in reaching 25,500 ft. when they were forced by the weather to camp and send the porters back to Chang La. For thirty-six hours the storm lasted, and there was great danger of the whole camp being blown away. On the third day, still using the remaining oxygen, they reached a height of 27,235 ft., about half a mile from the top, when they were compelled to return.

One more attempt was made early in June by Mallory, Somervell and Crawford, but an avalanche, on the steep ascent to the Chang La, carried away seven of the porters, who were killed instantaneously. The monsoon had now arrived and all further attempts for the season were abandoned.

The results of the 1922 expedition were—heights of 27,235 ft. and 26,985 ft. were reached with and without oxygen; it was ascertained that there are no serious physical obstacles between the highest point attained and the summit. Camps were made at 25,000 ft. and 25,500 ft., but it was found that it was not possible from there to reach the top and return in one day. Oxygen was used for the first time, though its efficacy does not appear to have been definitely proved or disproved.

We now come to the third expedition, which was undertaken in 1924. This year Gen. Bruce was again the leader, but owing to illness he was obliged, shortly after the start, to hand over to Col. Norton who had been appointed second-in-command. The other members were Mallory, Somervell, G. Bruce, Odell, Beetham, Hazard, Irvine, Shebbear, Major R. W. G. Hingston, and Noel who was in charge of the photographic equipment which was to contribute so much to the finances of the expedition.

Darjeeling was left on March 25, the old Base Camp at the foot of the Rongbuk glacier being reached on April 29. The three camps in the glacier valley had then to be established and stocked, and the route to Camp IV on the Chang La made practicable for laden porters. This done, Camp V, 25,500 ft., would have to be similarly established and stocked and finally

Camp VI, at 26,500 ft., and possibly another camp (not marked on the map) at about 27,200 ft. "All this had to be done before the actual attempt could be made."

Camps I and II were established and stocked with Tibetan labour, while all above this were worked by the specially enlisted Nepalese porter corps, fifty-two strong. Early in these operations the occurrence of violent winds and snow impeded the work, obliterating the way which had been prepared a short time before. On the night of May 6–7, the thermometer fell to 21½° F. below zero. There were many sick porters at Camp III who had to be sent down to Camp II. In these circumstances it was not easy to keep up the morale of the porter corps. This first attempt got no further than Camp III. It was beaten by the weather and in the end the whole expedition had to retreat to the Base Camp; even this was only carried out with considerable difficulty. "So ended Round One with the mountain."

After a complete reorganisation of the porter corps a fresh start was made on May 17. By May 19 the expedition was in full occupation up to Camp III. The next operation was to tackle the route to Camp IV, which has already been mentioned as the most difficult obstacle. It was here that the seven porters lost their lives in 1922, so the greatest care had to be taken to guard against a similar accident, by finding a way clear of avalanches. This was found by Norton, Mallory and Odell. It proved to be a most exhausting operation, accompanied by several narrow escapes, especially for Mallory, who nearly lost his life by a fall into a crevasse. The establishment of Camp IV was undertaken by Somervell, Hazard and Irvine, using the way marked out by Norton and Mallory. Ropes were fixed at the worst places and a rope ladder was used for negotiating the chimney. Then came the rescue by Norton, Mallory and Somervell of four porters stranded at Camp IV. Incidents like this are most trying and exhausting for members of the climbing party just before they have to make the supreme effort to reach the summit, yet such occurrences cannot be avoided.

The next effort was made by Norton and Somervell with the help of three gallant porters. They pitched a tent at Camp VI, 26,800 ft., and sent the porters back to the Chang La. The night was spent at this height and they slept fairly well. The next morning, June 4, they started at 6.45 for the summit which was about a mile off and 2,200 ft. above them. The going was good, the day perfect. At 27,500 ft. they both began to feel symptoms of distress. Norton felt very cold and had trouble with his eyes; Somervell also was in trouble with his throat and had to stop often and cough. "Now seven, eight or ten complete respirations were necessary for each single step forward." They struggled on, however, to about 28,000 ft., when Somervell could go no further. Norton went on to 28,126 ft., when his progress became very slow. It was then 1 P.M. when he, too, was forced to give up. The cause of their failure was most likely due to want of fitness following the strenuous time they, with other climbers, went through in rescuing the marooned porters, and other exertions which should be avoided if the final climb is to be successful.

The last and final attempt was now to be made. Two climbers without oxygen had failed. It was the turn of others to try with oxygen: Mallory, the experienced mountaineer whose third expedition it was to Everest, and Irvine, the young undergraduate and Oxford blue. On June 7 they set out for Camp VI while Odell was in support at Camp V. On arrival Mallory returned his four porters to Odell and he and Irvine spent the night at Camp VI. In a note which he sent back with the porters to Odell he said, "the weather was perfect but the oxygen apparatus was a nasty load for climbing."

Nothing is known of what happened after this except that Odell saw them at 12.50 P.M. the next day much nearer their camp than he had expected they would be had they started early in the morning. Shortly afterwards the mist shut out the view and Odell saw them no more. That evening Odell returned to Camp IV, where Hazard was. The following day, as the climbers did not return, Odell, with two porters, reascended the mountain intending to visit Camp V and VI, but did not get further than Camp V, where he spent the night. The following morning the weather had changed, a strong and bitter wind was blowing. As he could not persuade the porters to go any higher he sent them back to Camp IV, going on himself alone to Camp VI. This time he took oxygen, though he does not seem to have derived much benefit from it. He eventually reached Camp VI but found no sign of Mallory and Irvine. After searching in vain further up the mountain for a couple of hours, he too was obliged to return. In a storm of gale force he reached Camp IV; it was evidently a forerunner of the approaching monsoon. Here Hazard was awaiting him. Next day they evacuated the Chang La camp. Thus ended the last assault on Mount Everest.

A great adventure deserves a great narrative. The story of Mount Everest has been told in three large volumes splendidly illustrated by the leaders and members of the three expeditions, in which every aspect of the subject has been dealt with in great detail. But this is not all, for these narratives have been admirably summarised and woven into a single story entitled "The Epic of Mount Everest", by Sir Francis Younghusband.

What are the chances of success in 1933? A great deal, in fact almost everything, depends on the weather, and in weather we include wind. The very best laid plans may be wrecked at the last moment by one of those sudden changes which occur in the high Himalaya without warning. Wireless might be used to receive weather reports from the Indian Meteorological Department, but whether they could give indications of the local changes is more than doubtful.

The climbers must be absolutely fit and have had an opportunity of acclimatisation, undisturbed by any incident calling for great exertion on their part, such as having to rescue porters from dangerous positions. Yet such incidents are liable to occur.

The margin between success and failure must always be small—that is what makes it such a great adventure. Many favourable conditions must conspire to take the climbers to the summit; without these, success is doubtful.

We have no information as to the plans of the new expedition but we fancy the same camps will be occupied up to, and including, Camp IV on the Chang La (22,990 ft.) with, perhaps, some form of portable hut at Camp III as has been suggested. Higher up an attempt may probably be made to establish three camps in order to climb the remaining 6,000 ft.

As regards oxygen, since 1924 a much lighter form of apparatus has been constructed, weighing only about 12 lb.*. While a high degree of acclimatisation will be aimed at by the climbers selected for the final assault, no doubt the latest form of light oxygen equipment will be provided, so that it can be used if required for the last portions of the ascent. Aptitude for acclimatisation appears to vary with the individual. With some persons, deterioration, due to remaining at high altitudes, may set in before acclimatisation has been fully attained; this has always to be reckoned with. We think, given reasonable luck, Everest will be climbed. If fortune smiles the summit will be reached.

The new expedition will be led by Mr. Hugh Ruttledge, formerly of the Indian Civil Service, who has had a great deal of Himalayan experience. The other members of the expedition are Mr. F. S. Smythe, leader of the successful Kamet expedition, with three of his companions—Capt. Burney, Dr. Raymond Green, and Mr. E. E. Shipton; Mr. Noel Odell, Mr. C. G. Crawford, Mr. Shebbear, members of former Everest expeditions; Messrs. Wyn Harris, J. Longland, G. Wood-Johnson, and Capt. Hugh Boustead, and possibly Dr. W. McLean as second doctor; Mr. L. R. Wager, of the Arctic Air Route Expedition, 1930-31, and Mr. T. Brocklebank.

* See NATURE, 128, 1037, Dec. 19, 1931.

Scientific Centenaries in 1933

By ENG.-CAPT. EDGAR C. SMITH, O.B.E., R.N.

THE year which has just closed saw the commemoration of the centenaries of many famous men, among whom were Scott, Goethe, Leeuwenhoek, Locke and Warren Hastings. Of especial interest to men of science was the commemoration of the tercentenary of Wren, while the celebration at Cologne of the centenary of Otto attracted considerable attention in the engineering world.

The closing month of the year also saw the commemoration of four other men distinguished as engineers or inventors. On December 7, the American Society of Mechanical Engineers at its annual dinner paid tribute to the memory of John Edson Sweet (1832–1916), a founder of the Society and once professor of engineering at Cornell, and to the memory of Alexander Lyman Holley (1832–1882), a singularly gifted man, whose monument in Washington Square, New York, describes him as "Foremost among those whose genius and energy established in America and improved throughout the world the manufacture of Bessemer steel". Eight days later, on December 15, a ceremony took place at the base of the Eiffel Tower to commemorate the centenary of the birth of its constructor, Gustave Eiffel (1832–1923), while on December 23 various tributes were paid to the memory of Sir Richard Arkwright (1732–1792) who reduced to practice the principle of roller drawing in spinning machines, and was the founder of the factory system of cotton manufacture as we know it to-day. Lecky, the historian, speaking of the wealth which accrued to Great Britain through the cotton mill and the steam engine, and the power this wealth gave the country for carrying on the great French wars, declared that Arkwright and Watt deserved statues beside those of Wellington and Nelson, but so far no monument has ever been erected by his countrymen to Arkwright.

Earlier in the year, at Camborne, Prince George unveiled a statue of the Cornish engineer, Richard Trevithick, the centenary of whose death, falling on April 22 this year, will be commemorated by the engineering world on a scale in keeping with Trevithick's place as a pioneer. Trevithick died at Dartford, Kent, a poor man and for half a century was almost forgotten. The publication of his life by his son in 1872 did much to rescue his achievements from oblivion, and in 1888 a memorial window was erected to him in Westminster Abbey.

The forthcoming celebration is being supported by the leading engineering societies of Great Britain, and the arrangements are in the hands of a committee of which Sir Murdoch Macdonald is chairman. There will be memorial services in Dartford Parish Church and Westminster Abbey, an eminent engineer will deliver an address on Trevithick's work as an inventor, and the committee hopes to be able to erect tablets to Trevithick at his birthplace, Illogan, Cornwall, and also at Pen-y-daren, South Wales, and near Euston Road, London, to record his early attempts to introduce steam locomotion on roads and railways. Trevithick's reputation has never stood higher than it does to-day. He may indeed be proclaimed the father of the high-pressure steam engine.

Many other engineering centenaries also occur this year. A far less well-known inventor who died three months before Trevithick was Frederick König (1774–1833), whose four patents of 1810–14 led to the construction of the flat-bed printing press in which the paper was pressed against the type by a revolving cylinder. A red letter day in the history of printing was November 28, 1814, when the *Times* was first produced on a König machine driven by a steam engine.

Two centuries ago, on February 11, 1733, John Perry died at Spalding at the age of sixty-three years. For many years he was comptroller of maritime works under Peter the Great. He constructed harbour works in Great Britain and as the inscription on his tomb in Spalding Parish Church records, he was "Employed by ye Parliament to stop Dagenham Breach which he Effected and thereby Preserved the Navigation of the River of Thames and Rescued many Private Familys from Ruin".

Engineers born a hundred years ago include Sir Richard Tangye (1833–1906), the best known of the brothers who built up the great Cornwall Works at Birmingham; Thomas Edwards Vickers (1833–1915), another engineer and captain of industry of world-wide fame; James Robson (1833–1913), a pioneer of the gas engine; Henry Wilde (1833–1919), one of the leading inventors of the dynamo and Rudolph Haack (1833–1909) who at Stettin built the first ironclad constructed in Germany, and helped to lay the foundation of the German shipbuilding industry.

Turning to other fields of human endeavour, it is not necessary to stress the interest which is attached to the bicentenary of the birth of Joseph Priestley (1733–1804) who was born at Birstal, Leeds, and died at Northumberland, Pennsylvania. The statues of Priestley at Leeds, Birmingham and Oxford, testify to the esteem in which his memory has been held, and it may be recalled that it was at the celebration on August 1, 1874, of the centenary of his discovery of oxygen, on the piazza of his dwelling-house in Northumberland, that the American Chemical Society was founded, one of many instances of the value of such commemorations. Priestley was one of the few Englishmen elected a foreign associate of the Institute of France, the secretary of which, Cuvier, in his *éloge*, referred to him as "le père de chimie modèrne qui ne voulait pas reconnaître sa fille".

Among Priestley's intimate friends was the geologist and chemist, Richard Kirwan (1733–1812), who, like Priestley, received the Copley medal of the Royal Society. Kirwan was in correspondence with many of the leading savants of Europe, his London house was the meeting-place of the learned and after he returned to his native country, he became president of the Royal Irish Academy.

The year 1733 also saw the birth of Jean Charles Borda (1733–1799), the eminent French mathematician and astronomer; of Dr. Thomas Hornsby (1733–1810), the successor of Bradley as Savilian professor of astronomy at Oxford and the first Radcliffe Observer, and of the famous German traveller, Carsten Niebuhr (1733–1815), the pupil and friend of the astronomer, Tobias Mayer.

Somewhat later than these eighteenth century worthies came Joseph Nicephore Niepce (1765–1833), the French chemist, whose statue at Chalons recalls his achievement of obtaining sun prints on metal plates; Thomas Allan (1777–1833), the Edinburgh mineralogist; Adrien Marie Legendre (1752–1833), the French mathematician, writer of many works and the contemporary of Lagrange and Laplace. Legendre's "Elements of Geometry" was translated into English by Thomas Carlyle.

To the names of these three men who died in 1833 may be added that of Dr. William Babington (1756–1833), whose statue in St. Paul's Cathedral is regarded as a fine example of portraiture in marble. Babington was physician for many years to Guy's Hospital, and it was at his house that the meetings took place which led to the foundation of the Geological Society. Active to the last, when seventy-six years of age, he presided over the Priestley centenary festival on March 26, 1833, but died of influenza three days later. He is buried in St. Mary Aldermanbury in the City.

Coming nearer our own times, it is but natural that with increase of opportunity, the lists of men who make notable contributions to discovery and progress should grow longer. "Life," said Emerson, "is girt round with a zodiac of sciences, the contributions of men who have perished to add their point of light to our sky. These road makers on every hand enrich us." To this ever-increasing group of men belong many born in 1833, among them Sir Henry Roscoe (1833–1915); the German mathematician, Rudolph Clebsch (1833–1872); and the meteorologist, Robert Henry Scott (1833–1916), the successor of FitzRoy at the Meteorological Office. On April 15 was born Maurice Loewy (1833–1907), the constructor of the equatorial coudé and the successor of Tisserand as director of the Paris Observatory; on May 5, Ferdinand, Baron von Richthofen (1833–1905), the geologist and geographer; on March 16, Hilary Bauerman (1833–1909), the metallurgist and benefactor of the Iron and Steel Institute and the Royal School of Mines; and on June 29, Peter Waage (1833–1900), the distinguished Norwegian chemist, student of Bunsen, successor of Strecker and collaborator with Guldberg.

Then, too, on October 15 and October 21, 1833, respectively, occurred the births of Frederick Guthrie (1833–1886), through whose efforts the Physical Society of London was founded, and of Alfred Bernhard Nobel (1833–1896), the Swedish engineer, chemist and inventor of explosives, by whose will of November 27, 1895, the bulk of his great fortune was used for founding the famous Nobel prizes for physics, chemistry, medicine, literature and peace.

Empire Broadcasting

IN the field of radio communication, the last few weeks of the year 1932 were conspicuous for the inauguration of a regular broadcasting service between Great Britain and the various portions of the British Empire. The developments which took place in this connexion during 1932 are somewhat striking, and they are recorded in some detail in the B.B.C. Year Book for 1933. From the previous edition of this Year Book, it appeared that little progress was likely in connexion with the Empire broadcasting scheme drawn up by the British Broadcasting Corporation owing to lack of support by the Colonial and Imperial Conferences of 1930, and the responsible authorities in the overseas countries concerned. In November 1931, however, the B.B.C. announced its intention of developing the Empire broadcasting scheme on its own initiative, and the rapid progress made during the ensuing twelve months is illustrated by the fact that the regular service from the new station erected at Daventry for the purpose began on December 19.

As an aid in the development of this new broadcasting service, the B.B.C. had the benefit of about five years' experience with an experimental short wave station erected at the Marconi Company's works at Chelmsford. Owing to the fact that the distances from Great Britain to the various Dominions and Colonies are in the range 2,000–13,000 miles, it is necessary to make use of the short wave-length band of approximately 12–60 metres for radio communication. The Chelmsford station operated on a wave-length of 25 metres, and enabled a large amount of technical data to be obtained in connexion with short wave broadcasting. A little consideration of the matter will show, however, that one transmitting station working on a single wave-length cannot provide a satisfactory Empire broadcasting service. In the first place, account must be taken of the wide differences in local time in the various countries concerned, and it is obvious that the broadcast reception must be possible in general during the leisure hours of the inhabitants of those countries. Secondly, as a result of experience, not only in broadcasting but also with ordinary telephonic and telegraphic radio communication on short waves, it is known that the choice of the best wave-length varies with the distance to be covered, and whether the portion of the earth over which the communication takes place is in sunlight or darkness. Following on the latter condition, it is frequently found that diurnal and seasonal variations in the ionosphere, without which long-distance short wave communication would apparently not be possible, make it necessary to have a choice of at least two wave-lengths in order to maintain regular communication between two fixed points. Lastly, a directive antenna system at either or both ends of the communication link, makes such a vast improvement in general efficiency that the arrangement is always employed where possible in commercial short wave communication.

Based upon the considerations outlined above, the British Empire has been divided up into five zones and the new station at Daventry is designed to supply a direct broadcasting service to listeners in each zone, a two-hour programme being given daily between 6 P.M. and midnight local time, with the hours 8–10 P.M. as a focus wherever possible. For each zone a separate antenna array has been erected at Daventry, each array being so oriented as to give a not too highly concentrated beam of radiation in the desired direction. In the case of the first array, for Australasia, the transmission is limited to a single wave-length of 25·5 metres, but the radiator and reflector units of the array are reversible so that the waves can be transmitted around the earth in either direction. In the case of the other four zones, two or three wave-lengths are available as required. The approximate constitution of these zones, with the wave-lengths available, and the periods in G.M.T. at which the transmissions take place in Great Britain are given in the following table:

Zone.	Countries.	Wave-lengths (metres).	Approximate programme period (G.M.T.).
1	Australasia, including New Zealand, Borneo, New Guinea and the Pacific Islands	25·5	9.30–11.30 A.M.
2	India, with Burma and the Federated Malay States ..	17, 25 and 32	2.30– 4.30 P.M.
3	South Africa, with East Africa, Palestine, Sudan and Somaliland	14 and 32	6.0 – 8.0 P.M.
4	West Africa, Nigeria and Gold Coast, with Tristan da Cunha and Falkland Islands	32 and 48	8.0 –10.0 P.M.
5	Canada, Newfoundland and West Indies	19, 32 and 48	1.0 – 3.0 A.M.

In addition to the directional antenna arrays, six omnidirectional aerials have been provided and these will be used for transmitting any special programmes which it may be desired to receive at any hour in any part of the world.

These arrays and aerials are supplied by feeders or transmission lines from two transmitters housed in the new station building at Daventry. Each of these transmitters is of modern design and construction, and comprises a crystal-controlled master oscillator followed by the necessary frequency multiplying, modulating and energy amplifying stages: these terminate in a final amplifier which consists of four 15 kw. valves connected in push-pull arrangement, the output circuits of which are coupled to the aerial feeder.

The programme supplied through this station will comprise items largely of an original or topical nature, having entertainment or news interest of a type not normally obtainable in the countries where reception takes place. Owing to the difficulties of arranging repeat performances, particularly at the more inconvenient times shown in the above table, the B.B.C. will make extensive

use of modern electrical methods of programme recording for use in the transmitters. As an example of the use of the station, reference may be made to the occasion of the broadcasting of the King's Christmas message on December 25 last, when the vision of Sir Ambrose Fleming and other pioneers of radio communication, of a single human voice addressing listeners over the whole surface of the earth, was realised. In addition to being transmitted by all the B.B.C. stations serving Great Britain, it was sent through the two Empire transmitters at Daventry. One of these was connected to the Indian zone array, for which zone the transmission took place at the normal time. The other short wave transmitter was operated on a wave-length of about 20 metres, and supplied an omnidirectional aerial, so as to broadcast so far as possible in all directions. In addition, the programme was recorded by Blattnerphone and used for re-transmission in the various zone programmes later in the day.

In addition to the direct reception from Daventry on listeners' private receiving sets, it is likely that the broadcasting authorities in the Dominions will arrange for the relaying of some programmes through their local stations operating on medium wave-lengths. From the point of view of the B.B.C., the whole Empire service will be experimental for a period of about six months, during which arrangements will be made to collect reports of reception from selected listeners in all parts of the Empire. R. L. S.-R.

News and Views

New Year Honours

THE New Year Honours List includes the following names of scientific workers and others associated with scientific work: *Baron:* Sir Thomas Horder, Bt., senior physician to St. Bartholomew's Hospital. *Knight of the Thistle:* The Right Honourable Sir Herbert Maxwell, Bt., chairman of the Royal Commission on Scottish Historical Monuments, president of the Society of Antiquaries of Scotland, 1900–13. *K.C.B.:* Sir Frederick Leith-Ross, chief economic adviser to His Majesty's Government. *K.C.I.E.:* Major-General J. W. D. Megaw, Director-General of the Indian Medical Service. *K.C.V.O.:* Mr. F. J. Willans, surgeon apothecary to H.M. Household at Sandringham. *Knights:* Mr. C. A. Cochrane, chairman of the Council of Armstrong College, University of Durham. Mr. H. H. Dalrymple-Hay, consulting engineer, for his inventions and services in connexion with the construction of tube railways. Prof. F. T. G. Hobday, Principal and Dean of the Royal Veterinary College. Mr. A. J. C. Huddleston, lately economic adviser to the Sudan Government. Mr. J. L. McKelvey, for services to surgery in the Commonwealth of Australia. Mr. E. R. D. Maclagan, Director and Secretary, Victoria and Albert Museum. Mr. W. Perry, president of the Royal Agricultural Society, New Zealand. Mr. R. S. Rait, Principal and Vice-Chancellor of the University of Glasgow since 1929. *C.H.:* Rev. John Scott Lidgett, president of the Methodist Church, Vice-Chancellor of the University of London in 1930–31 and 1931–32. *C.M.G.:* Dr. J. J. C. Bradfield, Government engineer, Sydney Harbour Bridge, State of New South Wales. Prof. D. B. Copland, professor of commerce, University of Melbourne. Mr. L. Ennis, constructing engineer for Messrs. Dorman, Long and Co., Sydney Harbour Bridge, New South Wales. Mr. W. B. Johnson, director of Medical and Sanitary Service, Nigeria. Mr. W. J. U. Woolcock, formerly general manager of the Association of British Chemical Manufacturers, chairman of the Committee of Non-official Advisers associated with the industrial advisers of the United Kingdom delegation at the Ottawa Conference. *C.I.E.:* Major-Gen. W. C. H. Forster, Surgeon-General with the Government of Bombay. Lieut.-Col. R. B. Seymour Sewell, director of the Zoological Survey of India. Mr. C. G. Trevor, chief conservator of forests, Punjab and North-West Frontier Province. Col. J. N. Walker, director of the Medical Department and Sanitary Commissioner, his Exalted Highness the Nizam's Government, Hyderabad, Deccan. *C.B.E.:* Mrs. Alice Baker, one of the founders of the Thomas Baker, Alice Baker, and Eleanor Shaw Medical Research Institute, Melbourne, Commonwealth of Australia. Dr. F. H. A. Marshall, reader in agricultural physiology in the University of Cambridge. Dr. S. W. Smith, chief assayer, Royal Mint, and president of the Institute of Mining and Metallurgy. Dr. H. A. Tempany, director of agriculture, Straits Settlements and Federated Malay States. Prof. H. E. Whitfeld, Vice-Chancellor of the University, State of Western Australia. *O.B.E.:* Dr. J. T. Bradley, chief medical officer, Seychelles. Mr. A. V. Elsden, War Department chemist, Royal Arsenal, Woolwich. Mr. A. McCallum, senior inspector for agricultural education, Department of Agriculture for Scotland. Mitharam Pribhdas Mathrani, executive engineer, Left Works Division, Lloyd Barrage Circle, Sukkur, Bombay. Dr. S. A. Neave, assistant director, Imperial Institute of Entomology. Mr. J. Smith, director of animal health and acting secretary for agriculture, Northern Rhodesia. Mr. H. W. O. Taylor, executive engineer, Right Works Division, Lloyd Barrage Circle, Sukkur, Bombay. Mr. R. S. Taylor, principal medical officer, Somaliland Protectorate. *M.B.E.:* Mr. J. Coelho, assistant Crown surveyor and assistant engineer, Public Works Department, Gibraltar. Mr. W. M. Schutte, agricultural engineer to the Government of Bombay. Mr. H. N. Williams, assistant engineer, Irrigation Department, Iraq.

Calendar of Nature Topics

FOR the past nine years calendars have been published in our columns recording week by week notes of historic interest relating to people and

institutions, discoveries and inventions, customs, festivals, geographical exploration and other matters appropriate to a scientific "Book of Days". We began in 1924 with "Early Science at the Royal Society", and during last year appeared a "Calendar of Geographical Exploration", which was contributed by Miss R. M. Fleming and most admirably fulfilled its purpose. With this issue begins an annual cycle of a different kind relating to natural history in a wide sense, as was understood, for example, by Gilbert White in the notes and letters which make up his famous "Natural History of Selborne". Prof. James Ritchie, Regius professor of natural history in the University of Aberdeen, will be chiefly responsible for the weekly notes in this "Calendar of Nature Topics", and Dr. C. E. P. Brooks will deal with meteorological events of topical interest. In addition, we hope to receive occasional notes on such subjects as agriculture, botany, marine biology, fisheries and similar branches of pure and applied natural history from other contributors.

IT is not intended that this year's Calendar shall be of the usual type, recording aspects of Nature or country life week by week in Great Britain, but that it shall take a much wider outlook. The main idea will be to bring together, in chronological sequence throughout the year, observations and conclusions representing ascertained knowledge to-day on the subjects of the notes; and the range of the natural occurrences or phenomena may be that of the whole world. It is unlikely, therefore, that there will be any lack of suitable material; nevertheless, suggestions of topics of interest for inclusion in this new Calendar, or short notes which might be used, would be helpful and should be sent to Prof. Ritchie at the University of Aberdeen. It need scarcely be said that any such communications should be sent well in advance of the dates to which they refer.

Centenary of Legendre, 1752-1833

THE centenary occurs on January 10 of the death of the eminent French mathematician, Adrien Marie Legendre, whose labours over a period of sixty years were contemporary with those of Lagrange and Laplace, with whom he formed part of "that constellation of mathematical talent of which Paris was for more than two generations the main centre". Legendre was eighty years of age when he died, having been born at Toulouse on September 18, 1752. He was educated at the Collège Mazarin and at the age of twenty-five became a professor at the military school in Paris. He published his first important memoir, on attractions, in 1783, and in that year he was elected a member of the Paris Academy of Sciences. Four years later, with Cassini and Mechain, he was appointed to conduct the geodetical operations for connecting the Observatories of Paris and Greenwich. Through this he visited London, and was made a foreign member of the Royal Society. Unlike many of his contemporaries, he passed through the Revolution unscathed and by his writings and his work on commissions continued to add to his reputation. In 1795 he became a member of the staff of the famous École Normale. His chief works were his "Géométrie" (1794), which was translated into English by Thomas Carlyle, his "Théorie des Nombres" (1798), "Calcul Intégral" (1811–1826) and "Fonctions Elliptiques" (1825–26). A few weeks before his death he added to the last of these another volume, which contained some of the researches of the younger mathematicians, Abel and Jacobi, the value of whose work Legendre quickly recognised. Among the best-known pupils of Legendre were Cauchy and Arago. The death of Legendre took place at his house at Auteuil.

Sir Henry Roscoe, 1833-1915

AMONG those whose efforts aroused Great Britain to a realisation of the value of scientific education few did more than Sir Henry Enfield Roscoe, whose birth took place in London on January 7, 1833, a century ago. The son of a judge and a grandson of William Roscoe the historian, he got his second christian name from a great-grandfather, Dr. Enfield, a colleague of Priestley's at Warrington. He was sent first to Liverpool High School and afterwards to University College, London, where he came under the influence of Graham and Williamson. Later, he spent some time under Bunsen, working in the historic old laboratory at Heidelberg where "beneath the stone floor at our feet slept the dead monks, and on their tombstones we threw our waste precipitates". Returning from Germany, Roscoe at the age of twenty-four years was appointed to succeed Frankland at Owens College, Manchester, a position he held with conspicuous success for thirty years. He was one of the foremost in engendering a spirit of research and many of his students afterwards rose to high rank. His collaboration with Dittmar, Harden and Schorlemmer, the first professor of organic chemistry in Great Britain, led to the publication of many notable works some of which are still sought after. One of his achievements as an experimentalist was the isolation for the first time of vanadium. He was elected a fellow of the Royal Society in 1863 and awarded a Royal medal in 1874; he served as president of the Society of Chemical Industry in 1881, and as president of the Chemical Society in 1882. He was elected member of parliament for South Manchester in 1885; in 1887, the year in which he retired from Owens College, he was president of the British Association. He was a member of various Royal commissions, and from 1896 until 1902 was Vice-Chancellor of the University of London. His eightieth birthday was marked by the presentation of his bust to the Chemical Society. He died on December 18, 1915, at Woodcote Lodge, West Horsley, Surrey, and was buried four days later in Brookwood Cemetery.

North Atlantic Gale

THE last day of the old year and the first few days of the new have proved remarkably tempestuous on the North Atlantic. During the near approach to Ireland on December 31 of an exceptionally intense

cyclonic depression, a destructive gale occurred in Ireland. At Valentia Observatory the pressure tube anemograph registered a gust of 96 miles an hour, which is the highest gust recorded there for at least sixteen years. Barometric readings in Iceland were unusually low during the three first days of 1933. On January 3, pressure at sea-level was less than 928 millibars (27·4 in.) near the centre of a depression lying off the south-west coast of Iceland, but it is not possible to say by how much it fell below that value. That depression was certainly among the deepest of which we have any record since daily synoptic weather charts of the North Atlantic were first begun. On those prepared and published by the Danish and German Admiralties, there is only one depression which looks to have had such a low reading, that of February 24, 1903, which had been preceded five days earlier by another only slightly less intense.

Earthquake in South-East Africa

THE strong earthquake that occurred shortly after 8.30 A.M. on December 31 in south-east Africa possesses some interest as it visited a region in which destructive shocks are almost or quite unknown. Its epicentre seems to have been in Zululand, for damage to buildings was caused at Eshowe and other places. The shock was felt all over Zululand and Natal, in various parts of the Transvaal and the Free State, and from Lorenzo Marquez on the north to the Transkei on the south. Its disturbed area must therefore have contained about a quarter of a million square miles, which is more than that shaken by the great Japanese earthquake of 1923.

Ancient Man in Palestine

IT is reported that Miss Dorothy Garrod, director of the Joint Expedition of the School of Archæology in Palestine and the American School of Prehistoric Research, has discovered further remains of Palestine man. A massive and powerful lower jaw has been found in the cave of the Oven at the foot of Mount Carmel. In an announcement of the discovery by Dr. Grant MacCurdy, of Yale University, director of the American School of Prehistoric Research, it is stated that the character of the newly discovered jaw fully conforms to the view, based upon the evidence previously discovered in the caves of Mount Carmel, that Palestine man, while presenting Neanderthaloid characters, is of a distinct type. It is also announced that a cap or veil made of dentalia shells has been discovered in an adjacent cave. It will be remembered that in the course of the excavations of 1931, Miss Garrod found a cap of dentalia shells still attached to a skull from a mesolithic series in one of the Mugharet el-Wad caves.

Cave Paintings in the Pyrenees

FURTHER details of an interesting discovery of the prehistoric painting of a horse in a cave in the Pyrenees, briefly announced some weeks ago, are now supplied by Science Service, Washington D.C. The cave, to be known as La Grotte de la Bastide, is situated near the village of La Bastide, Hautes Pyrénées, and was discovered by M. Norbert Casterat, pupil of Count Bégouen. At the entrance of the cave were intact Magdalenian hearths, and on the walls were a number of engravings and polychrome paintings, including human figures, and as the central object, a polychrome painting of a horse. The horse is described as 'superb' and is an artistic production comparable with the famous horse of the Altamira cave at Santander. The figure is more than six feet long, and is executed in red with black muzzle. The mane is erect; the eye, ear and nostril being delicately engraved. High lights are indicated on shoulders, stomach and flanks. Judging from this description, the painting would appear in every way to be an exceptionally fine example of cave art.

Lightning Investigation

MR. W. H. F. TREDRE, honorary technical secretary of the Educational Section of the South African Institute of Electrical Engineers, Kelvin House, 100 Fox Street, Johannesburg, has favoured us with some interesting particulars relating to the organisation which has been established for the study of lightning in South Africa. The movement was initiated by Mr. T. P. Pask in a paper read before the South African Institute of Electrical Engineers in April 1930; as a result a committee was formed under the chairmanship of Mr. Pask. The present organisation consists of a main committee and three subsidiary committees dealing with each of the subjects research, statistics and education. With regard to the research, the chairman is Dr. B. F. J. Schonland, of Capetown—the scope of the work it is proposed to undertake includes the collection of photographs of lightning strokes and their effects taken by means of revolving lenses of the type suggested by Prof. Boys, of klydonograms and cathode ray oscillograms of lightning waves, point discharge work, etc. The activities of the statistical section may be illustrated by the fact that there are 3,500 observers throughout the Union who are collaborating by making notes on the history of storms. These observers are working under the supervision of Mr. G. W. Cox, acting chief meteorologist of the Union. The educational section will disseminate information on protective measures through the medium of the Press, schools, pamphlets, etc. During the 1933 session it has been arranged for certain of the investigators to read papers on the subjects of their work before the South African Institute of Electrical Engineers. It is anticipated that interesting results will be obtained at the end of the present lightning season.

Electrification of Railways in Britain

IN a paper by F. Lydall to the Institute of Transport read on December 12, the electrification of railways is considered under two headings, 'suburban passenger' and the 'general' electrification usually referred to as main line electrification. The main characteristics of the former type of traction are rapid acceleration and increased terminal capacity due to the elimination of locomotives and the ability

of the trains to run equally well in either direction. The practically universal adoption of the multiple unit system for suburban traffic, where several coaches throughout the train are provided with motors, proves that the flexibility this gives to the make-up of the train is of great value in practice. It is usual to divide the trains into units, each unit consisting of one motor coach and several trailer coaches. In the new express service from London to Brighton, the trains are made up of six or twelve coaches, two or four of which are motor coaches, each being equipped with four 225 horse power motors. Over a new portion of an American railway where the stops are 1·55 miles apart, the average speed including stops is 31 miles per hour; on another portion of the line where the stops are 2·9 miles apart the average speed is 40 miles per hour. The increase over the speed of steam trains in Great Britain is about 50 per cent. This speed could be easily increased; it is merely a question of cost. Mr. Lydall considers that on main lines it would be found advisable to work not less than one third of the passenger train mileage by multiple unit stock. By electrification the average speed of passenger trains in Britain could be raised by 25 per cent. The combination of greater comfort, higher speed, and more frequent service would attract many more passengers, and the latter two would also enable the railways to recover much of their goods traffic which at present goes by road transport.

Motor Car Lights on the Road

WHEN motor cars pass each other at night time, there is often a blinding glare in the drivers' eyes. We learn from *Science Service* that, in the United States, the Bureau of Standards has been conducting an extended research on head-lights to discover how glare can be avoided. Dr. Dickinson of the Bureau of Standards concludes that the most important difficulty in obtaining safe head-lighting is the great disparity in brightness between beams from different lamps. One head-light beam is frequently ten times as intense as another. The driver with the dim lights experiences an almost complete lack of visibility when his car plunges into the bright light of the approaching car. Dr. Dickinson suggests that if the lights were kept so that no head-lamp was more than two or three times brighter than another, most of the glare problem would be solved. Most drivers rely on what they can see of the curb rather than what they see of the oncoming car. Hence the light is increased for a hundred feet in front of the car and the beam is widespread horizontally and slightly depressed. Few motorists realise that it is more dangerous to pass a car that is standing still than one that is running fairly fast. A driver in judging whether the road is clear relies on what he has seen during the past few seconds by the light of the oncoming car. But the road immediately at the back of a car at rest is not illuminated in this way and so danger may lurk there unseen. Exposed lights along the roads sometimes increase the risks of night driving. They often make objects almost invisible which could easily be seen by the head-lights alone.

Early Days of the Turbine

IN his inaugural address as chairman of the North-Eastern Centre of the Institution of Electrical Engineers, Mr. C. Turnbull gave interesting reminiscences of some of the initial difficulties Sir Charles Parsons met in perfecting the steam turbine. His experiments with early forms of the turbine were in entirely new and unexplored regions of engineering. Everything had to be found out. Steel discs were run under stresses that no one could calculate and no one knew whether they were safe or not. The early high-speed turbines ran at 4,800 revolutions a minute. But thanks to the wonderful care always taken at Parsons's works, accidents were very rare. When driving dynamos at high speeds, the armature reaction caused great difficulty. Several solutions were adopted for turbo-alternators. In one way the brushes were moved automatically with the load by steam pressure and the variation of the strength of the field was counteracted by special windings. A further difficulty was that owing to the springing of the shaft, the connexions between the armature and the commutator used to give trouble. This was overcome by the use of flexible connectors, a device first proposed by Parsons. It has proved of the greatest value. Details are given of the famous *Turbinia* and the heartbreaking experiences with the destroyers *Viper* and *Cobra*. Mr. Turnbull tells how Parsons refused to give up and how his perseverance ultimately led to success. Another great invention that came from Parsons's works was the invention of means for balancing high-speed machinery. The early days of the steam turbine were hard days and the labour expended seemed to lead to nothing. At one time it was doubtful if the steam turbine would ever become practical. The story of Parsons's life should prove very encouraging to young and old inventors.

The New Helm or Steering Orders

THROUGH the work of the International Safety at Sea and Load Line Convention, and the passing of the Merchant Shipping Act, 1932, and in accordance with the subsequent instructions of the Board of Trade, on January 1 the 'direct' system of helm orders came into use on all British vessels. For centuries the order to "Starboard the helm" or "Port the helm" has caused the ship's head to go in the opposite direction, the practice having come down through the centuries when tillers were in use. Under the new regulations the order "Starboard" will be given, when it is intended that the wheel, the rudder blade and the head of the ship should go to starboard, and the order "Port" will be given when it is intended that the wheel, the rudder blade and the ship's head should go to port. Though it is expected that little difficulty will be experienced in changing over from the 'indirect' system to the 'direct' system, for a time the orders will be given in the words "Wheel to Starboard" and "Wheel to Port", thus enabling the helmsman to adapt himself gradually to the new system. Like most innovations of the kind, the change in

established practice has not been introduced without considerable criticism and opposition, but it is probable that in a very short time it will be regarded as an eminently sensible and desirable alteration.

Research at the Port Erin Biological Station

A SEPARATE report on the work of the Port Erin Biological Station has been discontinued and a survey of the research done is now published in the "Report for 1931 (No. 40) on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Annual Report of the Marine Biological Station (No. 45) at Port Erin, Isle of Man", 1932, edited by the late Prof. James Johnstone and Dr. R. J. Daniel. In this report a large amount of original work is also published. This covers a wide field and deals with the abdominal musculature of Crustacea, herring investigations, hydrography and the fauna and flora of the Isle of Man. The Port Erin Station has recently (1931–32) had a new laboratory added, fully equipped for practical teaching and with about thirty work places. New engines and pumps have been installed. The plaice hatchery and lobster culture are still continued. Besides liberating lobsterlings hatched and reared in the laboratory, a number were placed singly in glass rearing jars and fed on crab, boiled and ground to a fine meal. Nearly half of the number survived and cast their shells four or five times, making eight or nine casts between the period of hatching and the end of the first year. The newly hatched young are fed on fresh plankton; after the fourth moult (lobsterling) they are fed on crushed crab, small pieces of fish being added after the fifth month. These interesting experiments are to be continued on a larger scale next year. Dr. R. J. Daniel has completed his comparative work on the abdominal muscles of the Malacostraca and has drawn up an elaborate phylogenetic table to express the relationships that exist between the main ventral system of musculature.

A New Source of Rubber

IN order to avoid the necessity of importing rubber from tropical countries, the Soviet Government has organised investigations of native plants likely to contain this valuable product in their latex. Amongst various plants studied, several species of *Chondrilla* (Compositæ) occurring mainly in the southern sandy regions, proved to be very promising and their cultivation is being carried out on an extensive scale. Green parts of the plant are cut and rubber prepared from the latex. The quantities obtained must be rather small, since only up to 2 per cent of the green mass represents rubber. Recently, however, it was found that certain insects feeding on roots of *Chondrilla* can be utilised for extracting rubber from the latex (Veltischev and Luppova, *Priroda*, No. 10, 1932). One of these is a caterpillar of a pyralid moth, *Bradyrrhoa gilveolella* Tr., which feeds on the roots and constructs round its body a tube formed of condensed latex and sand grains. Up to thirty and more such tubes can be found on the roots of a single plant, and the tubes contain 9–17 per cent of rubber. Another useful insect is the larva of a buprestid beetle, *Sphenoptera foveola* Gebl., which also feeds on roots of *Chondrilla* and causes a large outflow of latex solidifying round the root. These swellings contain up to 4 per cent of rubber. Neither insect produces any serious effect on the infested plant, and healthy plants can be infested artificially in order to increase their productivity. Experiments are being made to test the practical and economic side of this method of obtaining rubber.

Cultivation of Green Crops

BULLETIN No. 53 of the Ministry of Agriculture and Fisheries ("Cabbages and Related Green Crops". London: H.M. Stationery Office, Price 9d.) has recently been published. It traces the botanical origin of the various green crops, and deals in detail with the soils, rotation, manuring, harvesting and marketing most suitable for cabbages, savoys, Brussels sprouts, cauliflowers and several miscellaneous green crops. A very interesting section deals with the saving of seed in the counties the climate of which is most suitable for this purpose. Pests and diseases are not mentioned in the present pamphlet, since they have been described very fully in other publications of the Ministry.

Astrolabes and Their History

ASTROLABES are not as generally available for study in the museums of the world as their scientific importance and artistic qualities would merit, but all who may desire to become better acquainted with this instrument in its various forms are now given the opportunity. Subscribers are invited for a comprehensive work, entitled "The Astrolabes of the World", based upon the series of instruments in the Lewis Evans Collection in the Old Ashmolean Museum at Oxford, in the Science Museum at South Kensington, and in several other public and private collections in Europe and America. The early Greek treatise on the astrolabe, by Philopon, and the Syriac treatise by Sabokt—both dating from the seventh century—will appear in English for the first time. Illustrations are given of Chaucer's astrolabe, now clearly identified by the character of the rete as depicted in MSS. and many instruments contemporary with Columbus and Drake, are figured. The subject is of fundamental importance to all students of the history of astronomy, geography and surveying, and indeed to the history of science generally, for it may truly be said that the astrolabe kept alight the torch of the scientific method of observation and of computation of results, in many countries, and through many dark ages, when larger instruments and well equipped observatories did not exist. It is hoped that the principal reference libraries may obtain copies of this monumental work, which it is proposed to issue in two quarto volumes, containing more than 600 pages and 155 plates, of which 12 are in collotype, and 216 text figures. The price to subscribers is ten guineas. Subscription forms may be obtained from Dr. R. T. Gunther, Curator of the Lewis Evans Collection, in the Old Ashmolean, Broad Street, Oxford.

World Power Conference

THE preparatory work of the organising committee at Stockholm of the next World Power Conference, which will take place in 1933 in Scandinavia, is proceeding steadily. The first plenary World Power Conference was held in London in 1924, the next in Berlin in 1930. There have also been sectional meetings with special programmes, for example, at Basel in 1926 and London in 1928. The Scandinavian Conference will be such a special meeting, dealing with the energy problems of large industry and transport. Participation and collaboration of fifteen countries outside Scandinavia is assured and more than 170 reports are announced. Some forty reports to be published at the meeting deal with problems of energy supply in large-scale industry, such as combined power and heat supply, the rôle of large-scale industry in national power schemes, etc. Many of the technical papers deal with the problems of long distance gas transmission, while other papers are devoted to more special power problems concerning the iron and steel industry, pulp and paper, and cement, sugar, textile and other steam heat consuming industries. Energy questions of transport provide the subjects for 62 reports; railway and marine transport, the peculiarities of city and suburban traffic are to be discussed with due emphasis on the new aspects which have been introduced by electric traction and Diesel engines.

Medical Research in South Africa

THE annual report of the South African Institute for Medical Research, by the director, Sir Spencer Lister, summarises the work of the Institute during 1931. Methods of dust estimation and studies on underground humidity in the air of the Witwatersrand mines have been pursued. The pneumonia attacking the native labourers in the copper mines of Northern Rhodesia has been investigated, and has been found to be caused by the *Streptococcus pyogenes* and other organisms, but rarely by the pneumococcus. This change of type of the organisms causing pneumonia has also been found in the Kimberley diamond mines. Much experimental work has been done on cancer, and Dr. des Ligneris has found that a micro-organism, *Salmonella gallinarum* of fowl typhoid, if cultivated in the tumour filtrate of the Rous fowl sarcoma for several generations, appears to have the power on inoculation of prolonging the life of fowls with the Rous sarcoma by about fifteen per cent.

The March of Influenza

ACCORDING to a report of Science Service, Washington, D.C., a considerable outbreak of influenza is in progress in several States of the Union, particularly in the south and west, the United States Public Health Service reporting 14,291 cases during the week ended December 3. In Great Britain outbreaks are reported in Southampton and Birmingham, and during the week ended December 17 in 117 great towns, including London, of England and Wales, 85 deaths from influenza were certified. In the same week Glasgow reported 28 deaths from this disease.

Announcements

THE following have been elected officers of the Royal Society of South Africa for 1933: *President*: Dr. W. A. Rogers; *Treasurer*: Dr. L. Crawford; *General Secretary*: Dr. B. F. J. Schonland.

THE Royal Society Mond Laboratory at Cambridge will be opened by the Chancellor of the University, the Right Hon. Stanley Baldwin, on February 3. It will be recalled that the hydrogen liquefaction plant of the Laboratory was described in NATURE for February 13, 1932, p. 224.

WE regret to learn of the death on December 25 of Prof. Paolo Enriques, professor of zoology in the University of Padua and president of the last International Congress of Zoology; he was just starting for Naples to pursue his researches in the Zoological Station. Also of Prof. James Johnstone, professor of oceanography in the University of Liverpool, formerly director of the Marine Biological Station, Port Erin, aged sixty-three years.

CATALOGUE No. 552 of Messrs. Francis Edwards Ltd., High Street, Marylebone, W.1, includes a miscellaneous collection of books, autographs and manuscripts, falling under such headings as Africa, America, Economics, Geography, History, First Editions, Scripture, Shakespeare and the like. There are also special series such as the publications of the Hakluyt Society and books from special presses such as the Kelmscott and Doves Presses. Among the books listed under Africa to be noted especially are Angas "The Kaffirs" with the coloured lithograph plates (£21) and a copy of the 1727 folio edition in Dutch of Peter Kolben's famous and invaluable account of the Cape of Good Hope (£15). The most notable item offered, however, is George Lily's map of Britain, 1546, of which the only other known, and slightly inferior, copy is in the British Museum, and was one of the six treasures selected from the British Museum for the International Geographical Congress in 1928. Apart from Ptolemy's atlas, this is the first printed map of Great Britain (£105).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A secretary of the Iron and Steel Institute and editor of the *Proceedings*—The Chairman, Appointments Committee, Iron and Steel Institute, 28, Victoria Street, S.W.1 (Jan. 21). A full-time tutor for the practical course in social science at the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, 73, Strand, W.C.2 (Jan. 31). A professor of textile industries at the University of Leeds—The Registrar (Feb. 28). A principal of the School of Metalliferous Mining (Cornwall)—The Secretary to the Governors, Camborne (March 31).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Disintegration of Light Elements by Fast Protons

SINCE the publication of our paper[1] on the disintegration of elements by fast protons, we have examined some of the light elements more carefully, using much thinner mica windows than we had previously employed on the high voltage tube. With the present arrangement, we can count particles which have passed through only 6 mm. air equivalent of absorber on their way from the target to the ionisation chamber.

In the case of lithium, we have found, in addition to the α-particle group of 8·4 cm. range, another group of particles of much shorter range. The number of these is about equal to that of the long range particles and their maximum range is about 2 cm. The ionisation produced by them indicates that they are α-particles. It will be of interest to examine whether any γ-rays are emitted corresponding to the difference of the energies of the α-particles in the two groups, but on account of the smallness of the effect to be expected, a sensitive method will be necessary.

In the case of boron, the number of particles observed increases rapidly as the total absorption between the target and the ionisation chamber is reduced. The maximum range of these particles is about 3 cm. and in our earlier experiments we determined the number of particles only after passing through the equivalent of 2·9 cm. of air, so that we were very nearly at the end of the range. Decreasing the absorber to 6 mm. of air gives an enormous increase in the number of particles. In this way about twenty-five times as many particles have been obtained from boron as from lithium under the same conditions. We estimate that there is roughly one particle emitted per two million incident protons at 500 kilovolts. The ionisation produced by the particles suggests that they are α-particles, and the energy of the main group would support the assumption that a proton enters the B^{11} nucleus and the resulting nucleus breaks up into three α-particles. There also seem to be present a small number of particles with ranges up to about 5 cm.

J. D. COCKCROFT.
E. T. S. WALTON.

Cavendish Laboratory,
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Dec. 22.

[1] *Proc. Roy. Soc.*, A, **137**, 229; 1932.

The Neutron and Neuton, the New Element of Atomic Number Zero

SINCE neutrons were first recognised by Chadwick in the rays from the beryllium nucleus, it may be of interest to note that in 1915 the hydrogen-helium theory[1] considered this nucleus to consist of two doubly charged helium nuclei and a condensed or nuclear hydrogen atom, now called a neutron. In a paper written early in 1919, the formula of the beryllium nucleus was given as $\alpha_2(\gamma\beta)$ which in more recent symbols is $\alpha_2(pe)$, where the parentheses were used to emphasise the idea that the proton p and the electron e are united to form a neutral group or neutron.

The suggestion that neutrons exist as separate atoms was made independently at practically the same time by Lord Rutherford (June 3, 1920) and myself (April 12, 1920).

The basis for my assumption of the existence of neutrons, was that it would be difficult for α-particles, on account of their double positive charge, to pass through the region of repulsion (now called the potential barrier) around nuclei of high positive charge in order to unite with the nucleus, but that electrically neutral particles "could easily pass into and through this region". "Such atoms might have masses 1, 2, 3 and 4, and possibly other values, and they would contain no non-nuclear electrons, so they would have no chemical, and almost none of the ordinary physical properties, aside from mass."[2]

While the question of stability is not discussed in this paper, it may be stated that at that time I did not consider any neutron of higher mass than 2 to exist more than momentarily except in a moderately heavy nucleus, but that the first quadruple neutron present in other nuclei is that in argon 40, the nuclear formula of which may be written $\alpha_e{}^{++}(pe)_4{}^{\circ}$ or $\alpha_e{}^{++}(\alpha e_2)^{\circ}$.

Since neutrons of unit mass (according to Chadwick about 1·006), and possibly those of mass two also, probably exist throughout space, and are concentrated by gravitation in the planets, and still more in the stars, they may be considered to constitute collectively an element. Since the atomic number of an element is determined by the magnitude of the charge on the nucleus of an atom of the element, the atomic number which corresponds to a neutron is zero; that is, the neutron is a nucleus with a zero charge. As a name for this new element, neutronium, neutronon, or neuteron have been suggested to me, but the name 'neuton' is more simple and preserves in it the suggestion of neutrality and also the final 'on' of the chemically indifferent elements.

To what extent the atoms of neuton partake in the partition of heat energy between molecules in general, is an interesting problem, since the collisions of the neutrons would be with nuclei and with electrons, rather than with atoms and molecules.

It is not improbable that the general formula for any nucleus, $(p_s e)_z(pe)_i$, proposed independently in 1921 by Masson and by me, may be shown to have a theoretical significance. If n represents a neutron, then this formula may be written $(pn)_z n_i$ in which z is the atomic, and i the isotopic number. For the neutron z is 0 and i is 1, for the proton z is 1, and i is -1, for oxygen 16, z is 8 and i is 0, and for the principal isotope of argon z is 18 and i is 4. It is evident that if all of the electrons are present as neutrons, then $z+i$ gives the number of neutrons, z the number of extra protons, and $2z+i$ the total number of protons. The numbers z and i are the most important in the classification of atomic species, and the value of i defines specifically the particular isotope, either known or unknown, of any element, either radioactive or non-radioactive.

WILLIAM D. HARKINS.

University of Chicago.
Nov. 8.

[1] Harkins and Wilson, *J. Amer. Chem. Soc.*, **37**, 1396; 1915.
[2] Harkins, *J. Amer. Chem. Soc.*, **42**, 1996 and 1964; 1920.

Kinetics of the Decomposition of Molecules of Intermediate Complexity

In a large class of gaseous chemical reactions, the mechanism is generally supposed to be the following. Molecules are brought into an activated state by collision. Most of the activated molecules are deactivated again, but during their existence there is a definite probability of their chemical transformation. As is well known, the relation between reaction rate and pressure under these conditions is such that the reciprocal of τ, the half life of the reacting substance, gives a curve of type 1 or 2 (see Fig. 1) when plotted against the initial pressure[1]. (The precise shape of the curve before it has become horizontal depends upon how the above mentioned probability varies with the total energy of the molecule[2].)

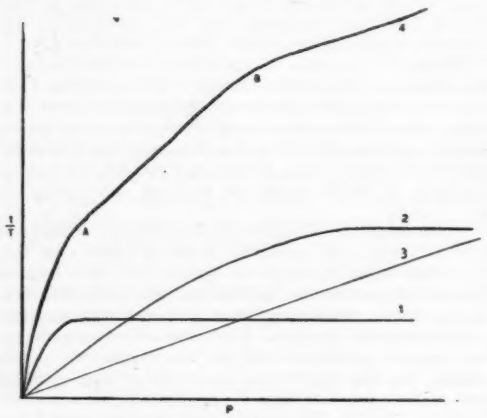

FIG. 1

In a molecule of moderate, but not too great, complexity, it seems possible that there may be several different modes of activation, corresponding to particular divisions of part of the energy among a limited number of vibrational (or rotational) states. To a first approximation, each of these modes may be associated with a separate probability of transformation, because, in the absence of collisions, internal redistribution may be difficult. Thus the total rate of reaction will be roughly the sum of several virtually independent reactions, each rate varying according to a curve of the type 1, 2, or 3. Since each of these reaches its limiting rate at a different pressure, the total rate may vary with pressure according to a segmented curve of type 4, with fairly pronounced changes of direction at *A*, *B*, and so on.

The simplest types of molecule may give curves which do not bend, at least up to high pressures, moderately simple molecules may give curves with a limited number of segments of decreasing slope, while complex molecules with many degrees of freedom give curves in which the segments merge into a single line without any noticeable changes of direction at particular stages.

The equation of the segmented curve in real examples will be very complicated, since the assumption of virtually independent reactions is to some extent an idealisation. Further, the variation of all the transformation probabilities with total energy may also complicate matters.

The object of this note, however, is simply (1) to suggest the desirability of exploring the hypothesis that the most general form of curve for molecules of 'intermediate complexity' is of the segmented type, and (2) to state that experiments on the decomposition of nitrous oxide at fairly low pressures (already published[3]) and further experiments on the decomposition of acetaldehyde (in progress) yield indications of the real existence of these different types of activated state.

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C. J. M. FLETCHER.

Balliol and Trinity College
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Dec. 8.

[1] Hinshelwood, "Kinetics".
[2] Rice and Ramsperger, Kassel.
[3] Musgrave and Hinshelwood, *Proc. Roy. Soc.*, A, **135**, 23; 1932.

'Hexuronic Acid' (Ascorbic Acid) as the Antiscorbutic Factor

In view of the facts that (1) hexuronic acid is the name of a class of substances rather than that of one individual compound, and that (2) the material described as hexuronic acid isolated from adrenal cortex and now from Paprika contains a molecule of water less than is required for a hexuronic acid, we wish to ascribe the name ascorbic acid to the crystalline substance $C_6H_8O_6$ which has been the subject of earlier communications from our laboratories.

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Dec. 19.

Methylnornarcotine, Glycuronic Acid, and Vitamin C

THE view that vitamin C is identical with methyl*nor*narcotine has been advanced by Rygh[1,2], who claims that narcotine occurs in unripe fruit and disappears with corresponding formation of vitamin C during ripening. According to Rygh, guinea-pigs receiving a scurvy-producing basal diet together with a suitable daily supplement of synthetic methyl*nor*narcotine lose weight and die but without any of the typical symptoms of scurvy. Other workers[3,4,5,6] have been unable to confirm this observation or to find narcotine in unripe fruit, and Dalmer and Moll[5] have shown that methyl*nor*narcotine as prepared by Rygh is not a single chemical substance.

In a later communication Rygh[7] has changed his ground and taken up the position that vitamin C is a complex, of which one component must be methyl*nor*narcotine while the other may be any uronic acid. Thus according to Rygh, the recently demonstrated anti-scorbutic activity of hexuronic acid is due to the contamination of the hexuronic acid by methyl*nor*narcotine, giving a mixture of the two components necessary for the make-up of vitamin C. This hypothesis was drawn from the observation that guinea-pigs were not only protected from scurvy but also grew normally if in addition to the basal diet they received daily 10 γ of "30 per cent methyl*nor*narcotine" and $\frac{1}{2}$ mgm. of glycuronic acid, although the glycuronic acid alone neither prevented scurvy nor supported growth.

I have attempted without success to confirm these

observations, using a specimen of glycuronolactone kindly given by Dr. E. L. Hirst, and two specimens of "30 per cent methyl*nor*narcotine", one prepared by Rygh and the other prepared in this laboratory. Young guinea-pigs were fed upon a scurvy-producing basal diet, and given a daily supplement of methyl-*nor*narcotine, or of glycuronolactone, or of both together, in the amounts specified by Rygh.[7] On the sixteenth day the animals were losing weight rapidly, so they were killed and examined for (*a*) hæmorrhage at the knee-joint, (*b*) rib-beading, and (*c*) suprarenal staining with dilute silver nitrate solution after Moore and Ray.[8] All those animals which had been receiving any of the supplements showed signs of marked or severe scurvy indistinguishable from the condition of the negative controls, while the positive control animals (which had received 10 gm. of cabbage daily) were free from scurvy. The lower jaws of all the guinea-pigs were removed for histological examination of the teeth, and full details of the experimental observations will be published elsewhere when this examination has been completed.

W. J. DANN.

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Dec. 7.

[1] Rygh and Rygh, *Z. physiol. Chem.*, **204**, 114.
[2] Rygh, Rygh and Laland, *Z. physiol. Chem.*, **204**, 105.
[3] Smith and Zilva, *Chem. Ind.*, **51**, 166.
[4] Grant, Smith and Zilva, *Biochem. J.*, **26**, 1628.
[5] Dalmer and Moll, *Z. physiol. Chem.*, **209**, 211.
[6] Dann, Forsyth, Harris, Mills and Innes, *Lancet*, **2**, 237; 1932.
[7] Rygh and Rygh, *Z. physiol. Chem.*, **211**, 275.
[8] Moore and Ray, NATURE, **130**, 997, Dec. 31, 1932.

Union of Pycniospores and Haploid Hyphæ in *Puccinia Helianthi* Schw.

THE discovery[1] that, in a heterothallic rust like *Puccinia graminis* Pers., or *P. helianthi* Schw., the transfer of pycniospore-containing nectar from a monosporidial (haploid) pustule of one sex to a similar pustule of the opposite sex induces the development of æcia in the pustule receiving the nectar has stimulated interest in the process by which the diploidisation is effected.

In the examination of free-hand sections of monosporidial pustules of *P. graminis* and *P. helianthi*, I have observed that usually two types of hyphæ protrude through the ostiole of a pycnium: (1) the stiff tapering slightly-curved paraphyses, which have been frequently figured; and (2) flexuous hyphæ which show considerable variation in length, diameter, regularity of outline, and a few other features. In some of the pycnia—probably the older ones—of a pustule, these flexuous hyphæ may show rather profuse development; in others, only a few of them, sometimes none, are discernible. They may be shorter, but usually they are as long or longer than the paraphyses, not infrequently two or three times as long. They may branch, but they rarely show septations. Some may be swollen at the tip. Occasionally a short spur or peg, of less diameter than a branch, juts out at a side or tip.

Several pycniospores in union with such hyphæ have been observed in sections of haploid pustules of *P. helianthi* in which the nectar had been previously intermixed, so that presumably both (+) and (−) pycniospores were present on the surface of each pustule and in close proximity to the protruding hyphæ.

Fig. 1 shows such a union. The pycniospore is empty; and the hypha has lost most of its cytoplasm. Presumably the nucleus of the pycniospore has passed through the connecting tube into the hypha and proceeded down it, to associate itself in conjugate relationship with some nucleus or the mycelium.

With regard to the short spurs or pegs on these hyphæ, it is assumed that a hypha of one sex, in response to the presence in its immediate vicinity of a pycniospore of the opposite sex, sends out a short tube to establish contact with that pycniospore.

A nucleus in the act of passing from a pycniospore into a hypha has not been seen, but empty pycniospores found connected by short tubes to these hyphæ furnish strong circumstantial evidence that nuclei migrate from pycniospores to these hyphæ by way of fusion tubes.

FIG. 1.—The union of a pycniospore and a flexuous hypha in a haploid pustule of *P. helianthi*. The pustule was fixed in formalin acetic alcohol 13½ hours after the intermixing of nectar was done. × approx. 1,500. Photograph by A. M. Brown.

Hyphæ which emerge through stomata and between epidermal cells were observed by Andrus[2] in haploid pustules of *Uromyces appendiculatus* and *U. vignæ*, and by Allen,[3] in haploid pustules of *Puccinia triticina*. Andrus regards these hyphæ as the tips of functioning trichogynes. Allen designates them "receptive hyphæ". However, neither of these investigators found direct evidence of fusions between 'spermatia' (pycniospores) and trichogynes or receptive hyphæ, although both assume from their studies that direct fusions do occur.

There is little doubt that, in haploid pustules of *P. helianthi* (or of *P. graminis*), the function of the protruding hyphæ is to establish contact between mycelia of one sex and pycniospores of the opposite sex and thus to serve as an avenue by which the nuclei of the pycniospores reach the internal mycelia of the pustules. The type of union so far observed simulates that of oidium and hypha in the Hymenomycetes.

J. H. CRAIGIE.

Dominion Rust Research Laboratory,
Winnipeg, Manitoba.
Nov. 17.

[1] Craigie, J. H., NATURE, **120**, 765, Nov. 26, 1927.
[2] Andrus, C. Frederic, *J. Agr. Res.*, **42**, 559–587; 1931.
[3] Allen, Ruth F., *J. Agr. Res.*, **44**, 733–754; 1932.

Breeding of Oysters (*O. edulis*) at Port Erin

THE success obtained by the Department of the Ministry of Agriculture and Fisheries in breeding oysters (*O. edulis*) in the experimental tanks at Conway and Lympne[1] suggested that a similar use might be made of the large outdoor tanks or ponds at the Port Erin Marine Biological Station. In normal summers the sea temperature in Port Erin Bay rarely rises above 59° F. seawards of the beaches, owing to the steepness of the beaches and the mid-sea position of the Isle of Man; the maximum is reached at about the end of August[2]. The stagnant water in the ponds, however, follows air temperature much more closely than the sea, and this year gave surface readings during July and the first three weeks of August ranging mostly between 62° and 65° F.; a range favourable for oyster breeding.

In February, a hundred Whitstable oysters were imported into the Port Erin tank system and distributed on April 14 experimentally on the bottom in different outdoor tanks. These oysters were examined on July 20. High mortality had occurred in the east tank where about a hundred plaice had been stored for breeding. On the bottom of this tank it was found that there had become deposited a black sludge bearing a luxuriant growth of green weed. Oysters which occurred in places where this sludge had accumulated were suffocated. Somewhat similar conditions obtained in parts of the west tank, though the sludge was less dense and the loss was not so heavy as in the east tank. Only one individual, however, among twenty-five had died in a small clean outside store tank through which a small circulation of water had been maintained.

The oysters from this latter tank (24 in number) were opened on July 20, when two individuals were found black sick, that is, carrying larvæ ready to be voided from the parent into the water. On July 13 the east tank had been refilled with water direct from the sea after the pond had been scrubbed out. In this pond most of the larvæ taken from the two black sick oysters were distributed on July 20. To this tank had also been added about a hundred plaice stored for breeding experiments in the following year.

On November 24 the tank was emptied and examined for oyster spat. A sprinkling only was found. Sixteen were found attached to the north wall of the tank in underhung places along with balanids, mostly remote from direct sunlight. Three occurred in the full glare of daylight on the bottom and near the middle of the tank; one settled on a varnished board and one on a stone, both in deep water near the outlet pipe; two occurred on mussel valves also on the bottom of the tank. The bottom and lower parts of the walls of the tank were covered with a growth of long delicate green weeds, 98 per cent of which were *Cladophora fracta*, Kütz, var. *flavescens* Batt. (*C. flavescens* Harv.), along with a little *Urospora isogona* Batt. and *Percursaria percursa* Rosenv.; there was very little accumulation of black mud. It is probable that a good fall of spat might have been obtained had settlers or a supply of cultch been placed in the pond. The spat varied in size from 6 mm. long by 6 mm. deep to 20 mm. long by 18 mm. deep, and fell into two size groups, suggesting that two periods of settling occurred, possibly a settlement from each brood of larvæ.

Ordinary sea-water of a salinity about 33·5 per thousand[2] pumped into the tank direct from the sea was used in this experiment; the salinity probably varied little during the first month of the experiment, as this was a period of drought and a little fresh sea-water was pumped into the tank from the sea daily. The plaice in the tank were fed on boiled mussels, the remains of which would contribute with the waste products from the plaice themselves towards manuring the water for the growth of those micro-organisms on which the oyster larvæ and spat thrived. A heavy growth of green weed is evidence of considerable production of motile reproductive bodies from these plants. These reproductive bodies may very well have formed a portion of the food of the larvæ and/or spat at some period. Scott's investigations[3] on the plankton of these ponds in 1924–26 indicate that in July and August the phyto-plankton (diatoms and dinoflagellates only) may normally be relatively scarce, or even absent: no plankton observations were made in 1932. A few *Gobius ruthensparri* and about four specimens of various species of small flatfish in the pond may have been inimical to a larger spatfall by feeding on the larvæ, as Dodgson and Sherwood[1] have found. 106 living plaice were recovered from the experimental tank in good condition on November 25.

The experiment is interesting in proving that under such meteorological and other conditions as prevailed in the summer of 1932, (*a*) oysters will spawn in the tanks at Port Erin; (*b*) the tanks are suitable for the production of young oysters; and (*c*) when the method of cultivating oysters in tanks has been improved so as to become a sound economic proposition, it may be possible in favourable summers to produce oyster spat in great numbers at Port Erin. The experiment also encourages the reasonable hope that such tanks as may be built in the future for mussel purification in the north of England may become as useful as those at Conway for oyster breeding.

We are indebted to members of the staff for taking valuable routine temperature records.

J. H. ORTON.
M. W. PARKE.
W. C. SMITH.

Zoology Department,
University, Liverpool.
Dec. 8.

[1] R. Dodgson and H. P. Sherwood, Oyster Breeding Experiments; in Reports on Sea Fisheries, Ministry Agric. and Fish., England and Wales, 1919 *et seq.*
[2] J. R. Bruce, *J. Mar. Biol. Assoc.*, Plymouth, **15**, 542; 1928.
[3] A. Scott, *Proc. and Trans. Biol. Soc. Liverpool*, **39** and **41**, 1925–27.

Reversible Stoppage of the Blood Circulation in Sabellids

SABELLIDS are marine polychæte worms, the blood system of which is peculiar, both anatomically and physiologically. Numerous capillaries are present, in the body wall, in the branchial crown, and projecting freely into the body cavity, all of them ending blindly. Most of the blood vessels in the body contract rhythmically. By peristalsis blood is forced along the continuous vessels, and at intervals of 10–20 seconds blood is expelled from the blind capillaries by regularly rhythmic centripetal contractions of their walls, to flow back again into these capillaries almost immediately. There may thus be said to be a true Galenic circulation in the capillaries. The blood contains the respiratory pigment chlorocruorin.

If a sabellid worm is put, under water, into a narrow glass tube, the rhythmic contractions of the blood vessels in its crown can be seen through the glass. Under these conditions the contractions continue for half an hour and then cease. But as soon as even the tip of the crown projects again beyond the end of the tube, the contractions recommence. Thus when worms in Nature have retired into their tubes for over half an hour their blood no longer circulates. Yet *Spirographis* can remain uninjured for eight hours inside its tube when the front end of the latter is artificially closed. After about eight hours the animal re-expands its crown through a new anterior lateral aperture which it forms by local digestion of the mucoid tube.

When a sabellid is put into sea water saturated with carbon dioxide, the pulsations of its blood vessels cease almost immediately. After the animal has been put back into pure sea water the pulsations recommence. Neither water lacking dissolved oxygen, nor water acidified with hydrochloric acid to the same *p*H as water saturated with carbon dioxide, stops the pulsations. The threshold *p*H for stoppage in water containing carbon dioxide is in the region of 6·0, varying slightly with species.

It has been concluded from a variety of experimental evidence that the natural inhibition of blood circulation when worms are in their tubes is due to an accumulation of excreted carbonic acid between the filaments of the closed crown, and that this carbonic acid does not act on the blood vessels through a nervous reflex, but it prevents the normal exit of carbonic acid produced in metabolism, which accumulates in the body and has a direct inhibitory action on the blood vessel walls.

A full account of this work will be published shortly.

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Dec. 6.

Photochemical Reaction of Hydrogen and Chlorine

I AM much surprised to read, in NATURE of December 17, that so fine an experimenter as Prof. A. J. Allmand has failed to inhibit the action of light on a mixture of hydrogen and chlorine, by drying. It is, with one exception, the easiest reaction with which to demonstrate the influence of traces of water on chemical action. So much so, that for many years it was one of my stock experiments in courses of elementary lectures.

Hydrogen and chlorine were generated by the electrolysis of hydrochloric acid, washed with water and conducted through a tube of phosphorus pentoxide for rough drying. The mixture then passed through a dozen thin bulbs blown in series on a tube of soft glass, in some of which had been placed phosphorus pentoxide. After about six hours, the wash water was saturated with chlorine, and half an hour later the bulbs were sealed off at their capillary joinings. The last bulb was exposed to the light of burning magnesium, and if it exploded after five seconds, the batch was assumed to be perfect. In lecture a pair of bulbs, one containing phosphorus pentoxide and the other not, were exposed to the same intensity of light and in no case did the dry gas ever explode, while the moist ones did so without exception. One of the dried bulbs was exposed to bright sunlight for three days, and analysis of the gas afterwards showed that one third of the mixture was still in the uncombined state. Mellor and Russell[1], in repeating this experiment, found that two thirds of the gas had resisted the action of light.

In describing these experiments to the Chemical Society, I did the experiment successfully; in fact, on the principle that 'seeing is believing' I have, almost without exception, demonstrated my results experimentally at the meetings at which the papers were read. Prof. Bodenstein and Prof. Allmand owe, I think, the failure of their experiments to the complexity of their apparatus. It is almost impossible, on account of the slowness of diffusion, to dry an apparatus which has any dead ends. Mere 'baking out' at 200° is insufficient, as I have shown over and over again, to get rid of deep-seated moisture in glass. Long continued contact of a gas with pure phosphorus pentoxide is the only way in which success can be attained.

At the risk of seeming egotistical, I would ask all who contemplate working in this field to read my paper[2] on "Manipulation in Intensive Drying". If they do so, they would, I feel sure, save themselves much fruitless effort.

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Dec. 22.

[1] *J. Chem. Soc.*; 1902.
[2] *J. Chem. Soc.*; 1929.

Limiting Mobilities of some Monovalent Ions and the Dissociation Constant of Acetic Acid at 25°

MACINNES, Shedlovsky, and Longsworth in reply[1] to our recent letter with the above heading[2] have asserted, without experimental evidence, that our conductivity technique was subject to errors and that the discrepancies between the results are to be attributed to this cause. We would, however, point out that by using the cell constant determined with 0·01 *N* potassium chloride by Parker and Parker's method[3] we have been able to reproduce Kohlrausch and Maltby's results[4] for KCl, NaCl, and KIO_3 at 18° over the range 0·0001 – 0·01 *N* to within 0·1 per cent,[5] and this, it appears to us, gives definite support to the view that our experimental results are trustworthy to at least 0·1 per cent.

Two limiting cation transport numbers for KCl are given in our paper[5], namely, 0·497 the old classical figure of Kohlrausch and Maltby[4], on which basis all limiting mobilities have hitherto been calculated, and 0·490 the most probable figure deduced from the results of MacInnes and Dole[6]. It was our original intention to redetermine this constant but owing to the transfer of the senior author to Woolwich, this project was abandoned. We now employ the figure 0·490, which appears to be the most probable value deduced from the determinations of MacInnes and Dole and of Longsworth[7]. The American authors state in their letter that their value for the limiting conductivity of the chloride ion, based on conductivity and also transport number measurements of KCl, NaCl, LiCl, and HCl at 25°, is 76·32 "within a few hundredths of a per cent"; the value deduced previously by us was 76·4[5] (n_k for KCl = 0·490).

The use of the empirical formula of Shedlovsky[3]

for extrapolation to infinite dilution seems unnecessary: the ordinary square root formula holds over a considerable concentration range when applied to Shedlovsky's results[9] for KCl, NaCl, and HCl at 25°. Further, the Shedlovsky equation is of limited applicability (it breaks down for KNO_3, chlorates and iodates) and the values for Λ_0 deduced from it for NaCl and KCl at 18° have actually been exceeded at experimental concentrations by Kohlrausch and Maltby[10] and by Wieland[11] respectively.

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G. H. JEFFERY.

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Nov. 30.

[1] NATURE, 130, 774, Nov. 19, 1932.
[2] NATURE, 130, 435, Sept. 17, 1932.
[3] *J. Amer. Chem. Soc.*, 46, 312; 1923.
[4] *Wiss. Abh. Techn. Reichsanst.*, 3, 156; 1900. *Ges. Abh.*, 2, 826; 1911.
[5] *J. Chem. Soc.*, 1715; 1931.
[6] *J. Amer. Chem. Soc.*, 53, 1357; 1931.
[7] *Ibid.*, 54, 2741; 1932.
[8] *Ibid.*, 54, 1405; 1932.
[9] *Ibid.*, 54, 1429; 1932.
[10] *Ges. Abh.*, 2, 886; 1911.
[11] *J. Amer. Chem. Soc.*, 40, 146; 1918.

'Raw' Weather

WITH the return of winter the following physico-physiological question once more calls for solution:—Very hot but dry weather may be tolerable, while moderately hot but very damp weather may be almost unbearable. The explanation of this in terms of cooling by evaporation is known to everyone. Again, while very cold dry conditions may be pleasant and invigorating, damp and rather cold weather—what is generally described as raw weather—is very unpleasant even to normal people, while it is peculiarly bad for those suffering from rheumatism and the like. So far as I know no explanation of this last effect has been generally accepted; indeed, inquiries of many physicists and not a few physiologists have failed to produce any suggestions regarding even the general lines along which a solution might be found. Any complete explanation must also account for the fact that damp air with a moderate temperature is far from unpleasant, as exemplified by the mild south-westerly conditions often occurring in the British Isles.

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HEAT expands and softens the tissues, bringing more blood and lymph into the parts: cold tightens them up. It is, I suggest, this change which leads to pain in rheumatic people. A sudden thaw is most trying.

Cold moist air has a much higher conductivity than cold dry air, and acting on the skin produces the raw feeling and excites the nerve endings which reflexly cause the tightening-up effect.

The action of certain infra-red rays in producing reflexly congestion of the nasal air way or the opposite affords a striking example of how skin stimulation produces reflex effects on deeper organs.

LEONARD HILL.

Isotope Effect in the Spectrum of Cadmium Hydride

IN an earlier paper[1], I dealt with the structure of different band systems in the spectrum of cadmium hydride. In several respects, however, my analysis suffered from incomplete resolution of the spectrum, especially regarding the isotope splitting of the band lines. Recently I repeated the investigation, using a large concave grating in the third order (0·6 A./mm.). Much work was devoted to the analysis of an extensive system $^2\Sigma^+ \rightarrow {}^2\Sigma$, covering a wide range of vibrational levels ($v' = 0$ to 13, $v'' = 0$ to 6) and thus forming a favourable case for an examination of the isotope effect. The band lines are here split into components belonging to Cd (114, 112, 110, 116), already known from the work of Aston.[2] Besides this, faint components appear belonging to isotopes Cd (118, 108), which have not been reported before. These components were found in every rotational line-group of a great number of bands, falling exactly in the position calculated (± 0·02 cm.$^{-1}$). I was not able to detect the components of the odd isotopes Cd (111, 113), due to their positions between the intense lines of Cd (110, 112, 114). Only in favourable cases could a diffuse blackening be distinguished between the components of Cd (110, 112), which may be related to Cd (111).

There are some peculiarities regarding the intensity distribution among the isotope components which may be of interest to mention. In bands belonging to the transitions $v' \rightarrow 0$, the lines of Cd (114) are somewhat more intense than those of Cd (112), while there is a considerable intensity difference between the lines of Cd (110) and Cd (116), in agreement with Aston's values. In transitions $0 \rightarrow v''$, the intensity distribution is changed in favour of the heavier isotopes. Due to this, I was able to trace Cd (118) only in the latter case, where it appeared stronger than Cd (108), while in transitions $v' \rightarrow 0$ only Cd (108) could be observed. These relations can be accounted for partly[3] by influences of the Boltzmann factor $e^{-h\nu/kT}$.

Detailed account of the analysis of this spectrum will be given shortly.

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University of Stockholm.
Nov. 24.

[1] E. Svensson, *Z. Phys.*, 59, 333; 1930.
[2] F. W. Aston, *Phil. Mag.*, 49, 1191; 1925.
[3] G. Stenvinkel, NATURE, 126, 649; 1930.

Chlorination of Sodium Benzoate

THE chlorination of benzoic acid in alkaline solution by means of sodium hypochlorite is often quoted as an example of the effect of ionisation on orientation. Lossen's experiments[1] have been repeated, and it is now found that the product of chlorination contains 48 per cent ortho-, 32 per cent meta- and 20 per cent para-chlorobenzoic acid. This is an unusual type of orientation.

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Dec. 14.

[1] Friedländer, 7, 115; 1903.

Research Items

Burial of a Bari Rain-maker. The burial of a rain-chief in the Bari country, Mongalla Province, Sudan, is described by Mr. A. C. Barton in *Sudan Notes and Records*, vol. 15, pt. 1. The rain-maker's last illness took place during a drought, and, as was ascertained by the performance of a special rite, had been caused by a more powerful rain-maker, who attributed to him the failure of his own efforts to bring rain. The grave was of a special type reserved for rain-makers, chiefs and influential freemen. It lay from east to west, and from the west, descent to the bottom of the excavation was by two steps cut in the earth. The interment chamber proper was cut laterally and frontally into the north and east sides of the excavation. The funeral ceremonies began with secret rites, to which only the close kin were admitted, in the house, which was closed immediately after death. These rites included the shaving and anointing of the corpse, the hair being placed in a calabash to be disposed of later in the bush. At the graveside, women who had not been present inside the house again anointed the body over its clothes, and the sons after anointing the back of the corpse down to the waist, again over its clothes, with ground and burnt semen returned to the house, observing a grass taboo, in walking, where they remained until earth had been thrown into the grave. A small son of a serf had been chosen as a serf of the dead, and when the corpse had been laid to rest in the chamber as on a bed, this boy remained by the corpse until it opened in final decay, when he came out of the grave and proclaimed the chief really dead. Large slabs of stone, sacking, etc., blocked the entrance of the cavity, so that no earth could fall on the chief, and above the grave were placed carved grave stakes, of which one had two prongs, a 'male' and a 'female', while the smaller is the 'sentinel'. These were brought from the father's grave and will remain on the chief's grave until required for his son's burial. A mourning feast and dance follow the burial.

The Malabar House. In commenting on a ballad of Kerala in the *Indian Antiquary* for November, Dr. M. D. Raghavan appends some notes on the Malabar house, which is highly conventionalised in plan and clearly has retained its main features unchanged for a very long period of time. The most characteristic dwelling-house of Kerala is called *nâlu-pura*, literally 'four-houses', being built round the four sides of a courtyard which is open to the sky, each room being named relatively to its situation with regard to the courtyard, that is, southern room, northern room or the three western rooms. Every house, however small, is regarded conventionally as a *nâlu-pura*, and hence a house of the smaller type, though facing east, is called *paḍiññâṟṟa pura*, that being the western block consisting of three rooms with a verandah in front. Usually behind the central room of the western block there is a small room called the 'lean-to'; and beside the inner verandah is an outer verandah with a long ridged roof on a beam supported by high pillars. The central of the three western rooms is the principal room of the house, containing the valuables and sacred to all household ceremonies. The main entrance is through a portico which serves the purpose of a drawing-room. Each house stands in a compound of its own, which is thickly planted with trees, and is enclosed by a massive bank of earth. A broad smooth walk, well rammed and plastered with cowdung, leads to the courtyard, of which the surface has been treated in the same way. The courtyard is used for drying paddy, pepper, etc., in the sun. It serves as a threshing floor, as the recreation-ground of younger members of the family, as an exercise ground in the use of arms, and as a place for ceremonial and social functions.

Facial Growth in Children. "Facial Growth in Children", by Corisande Smyth and Matthew Young (Medical Research Council. Special Report Series, No. 171), gives the results of a study of twenty characters of the face in 1,400 London children. The primary object of the investigation was to establish standards of normality. Measurements were made of some 1,200 selected children aged 8–14 years in the London County Council schools, 100 boys aged 9–10 years taken at random from a group of boys of the same age, and 100 children aged 2–5 years attending a welfare clinic. No measurements were made of children aged 5–8 years. This study confirms the findings of John Hunter, Tomes and Bolk that the dental arch does not increase in length after complete eruption of the milk teeth, but Smyth and Young find there is a definite increase in breadth of the dental arches after four years of age. As regards inter-relationships of the facial measurements, the most interesting result is the high association between the zygomatic breadth and breadth of the dental arches, an association denied by Korkhaus and other observers. There appears to be some tendency for a narrow face to be associated with a high palate but not necessarily with a narrow dental arch. Although all the results are based on selected children, that is, on those in whom normal occlusion has occurred, Smyth and Young consider they may be taken as fairly representative of London school children because of the close agreement found in the results for two groups of boys aged 9–10 years, one group selected because of normal occlusion, the other taken at random from the London schools.

Influence of Living-Space upon Growth. In the course of two years, experiments, fifteen in number, have been carried out by Dr. Jan Podhradsky with the object of deciding whether the size and shape of the living-space influenced in any way the growth and development of tadpoles of *Rana fusca* (*Bull. de l'Instit. Nat. Agron. Brno*, CSR., Sign. C. 20, 1931). It was found that size of living-space had a bearing on growth and development so that they followed their normal course only within certain limits of space, above and below which growth was depressed. In a small living-space the adverse factor appeared to be mutual disturbance amongst the tadpoles; in a large living-space the isolation of individuals seemed to be largely responsible. Shape of living-space also had a measurable influence: narrow and high vessels depressed growth because they enforced and exaggerated vertical movements on the part of the tadpoles and caused greater reciprocal disturbance, as well as allowing only a low absorption of oxygen at the surface. These effects were intensified

with the growth of the tadpoles. It was found also that abnormally low water depressed growth and development, and this relation was thought to be due to the unusual accumulation of excretory products and the fouling of food.

Age and Growth of Limpets. N. Abe (*Science Reports*, Tôhukur Imp. Univ., vol. 7, No. 3, 1932) has shown that colonies of *Acmæa dorsuosa* formed in spring and summer break up in autumn and winter but the individuals do not migrate more than 5–6 metres and hence are subject to the same environmental conditions every year. He has measured the individuals of such colonies and also other examples in which the shell clearly shows the annual rings. In limpets which live in wet places the growth-rate is greater, the thickening of the shell is slower and the height of the shell is relatively less than in those from a drier locality. The ratio of breadth to length of the shell is practically constant in individuals more than three years old. The weight of the shell is greater than that of the body (soft parts) in the proportion of 1 : 0·8. The frequency distribution of age in the colonies is asymmetrical; individuals of four years of age are most numerous. Specimens older than twelve years are few and it would appear that the maximum age of this limpet is about seventeen years.

Style-Sac of Gastropods. R. V. Seshaiya (*Rec. Indian Mus.*, vol. 34, pt. 2, 1932) notes that a crystalline style and style-sac have been recorded in ten families of prosobranch gastropods, and he now records them in two more families—Cerithiidæ and Assimineidæ. He refers to Randles' description (1902) of the posterior chamber of the stomach of *Turritella* in which the presence of a single fleshy fold and a crescentic groove is recorded, the groove being considered to be a vestigial cæcum and a very primitive feature. The author's examination of the stomachs of *Turritella* and of several other style-bearing gastropods does not support this view. The groove and the adjoining ridges or folds are functional structures and serve to accommodate the gastric shield and to direct the gastric contents towards the style.

Nutritive Value of Pastures. The fact that pastures which appear very similar may differ widely in nutritive value (stock-carrying and fattening capacity) has long remained without a satisfactory explanation, and an investigation of the problem has been made by E. J. Sheehy (*Sci. Proc. Roy. Dub. Soc.*, vol. 20). So far as the chemical composition of the dry matter of the organic portion of the herbage is concerned, no consistent difference was observed between good, mediocre and poor pastures in the same neighbourhood, and although a slight inferiority in the phosphate content of the inorganic portion did occur in the poorer herbage, the disparity was not large enough to account for its reduced feeding value. Further, the chemical composition of the dry matter of fiorin grass and plantain grown on soils carrying pastures of very different value, remained unaffected. The digestibility of such different types of pasture plants as perennial rye grass, Yorkshire fog and plantain were also found to be very much alike, so that differences in nutritive value could not be explained on this score either. The factor which proved to indicate the value of the pasture, however, was the percentage of dry matter, and in consequence the density of the sward is an important feature. The latter is largely determined by the botanical personnel, the narrow-leaved grasses yielding a higher dry weight per unit area than broad leaved plants such as weeds. Clovers occupy an intermediate position. Fattening capacity is, therefore, definitely related to the dry matter content and density of the herbage, but stock-carrying capacity is also affected by the rate of growth, as upon this property the provision of abundant feed depends.

Identification of Indian Sleeper Woods. In *Forest Bulletin* No. 77 (Economy Series, of the Forest Research Institute, Dehra Dun, 1932) Mr. K. A. Chowdhury, wood technologist, has produced a most useful little guide to enable forest officers, railway passing officers and others to identify on the spot some of the more common Indian sleeper woods. This bulletin is the first of its kind. Capt. Trotter in a preface says that it is hoped to publish similar bulletins from time to time dealing with timbers of individual provinces, that is to deal with timbers according to localities rather than uses. In the present case that method of treatment would not have been so useful, as the map appended to the bulletin well illustrates. This map "shows the various species of sleeper woods that grow in the areas in which different railway groups are concerned". These groups are five in number, namely, Northern, Central and Terai, Eastern, Southern and Burma. The map serves two purposes—the first and most obvious, the species which can be obtained from a given locality, and the second and the more striking, it can help in identification, as a species may easily be eliminated which does not occur in a particular locality. A few simple details on wood structure and so forth lead up to the key for the identification of more than fifty species of important Indian sleeper woods. This key is drawn up in the simplest fashion and appears to be easily workable, but as the author states, "quick and accurate identification of timbers can only be achieved after much practice". A sharp knife and a hand lens magnifying 10–12 times are all that are required to assist the key. Incidentally, the bulletin serves once again to show the importance to India as a whole of the research work being carried out at Dehra Dun in connexion with the enormously valuable Indian forest estate.

Spectroscopic Detection of Small Quantities of Elements. The *Wiener Berichte* IIb 141 contains a paper by W. Späth on the detection of very small quantities of elements by the spectroscope. Droplets of solutions were evaporated on silver or copper electrodes and the spectra were excited by condensed spark or by a break-contact arc, according to whether spark or arc lines are the more persistent in a particular case. The preparation of very pure silver electrodes was a long and troublesome matter, and the methods finally adopted are described in considerable detail. 10^{-10} gm. of cadmium was the smallest quantity which could be detected, using the arc line 2288 A. and the spark line 2265 A. In experiments with other metals, 10^{-10} gm. manganese, 10^{-7} gm. arsenic, 10^{-7} gm. tellurium, 10^{-9} gm. lithium and 10^{-11} gm. strontium could be detected. The limit is apparently set by the presence of a continuous background in the spectra which masks very faint lines, and it is suggested that a spectrograph with higher dispersion combined with high light gathering power would enable yet smaller masses to be detected.

Low Temperature Carbonisation of Coal. In accordance with the policy adopted by the Government some years ago, the Department of Scientific and Industrial Research has examined the Turner plant for the low temperature carbonisation of coal installed at the Comac Oil Co. Ltd., Coalburn, Lanarkshire. The report on the test issued by the Department (H.M. Stationery Office, 9*d*. net) shows that the retort is of the continuous vertical type, internally heated by superheated steam. A peculiarity is the use of a fluctuating pressure claimed to facilitate transfer of heat from the steam to the coke. From 1 ton of coal were obtained 13·4 cwt. of coke, found to be a good domestic fuel, 21·3 gallons of tar and spirit, 2,170 cub. ft. of gas of total heating value 18·7 therms, and 334 gallons of liquor of no value, although as an effluent it must be regarded as a distinct liability. The alternations of pressure are regarded as a necessary feature of this process, but tests made with the plant adjusted to give steady and fluctuating steam pressures to the retort gave substantially the same results.

Dewaxing and Acid Refining Mineral Oils. At a Congress of Polish Petroleum Technologists two years ago, the De Laval *S–N* method of dewaxing was for the first time made public. The data then were based principally on tests with Polish oils from Schodnica and Urycz. Tests were being carried out on a small plant, but since that time a larger centrifugal separator has been employed successfully, and it has been possible to treat pipe-still distillates in addition to those produced by other methods. An account of this process was given by Dr. Nils Olof Backlund on December 13 at the Institution of Petroleum Technologists. Among interesting points made was the substitution of trichlorethylene as a more suitable solvent for separating the wax from the oil than the time-honoured benzene. Rate and degree of cooling of the oil-solvent mixture are of the utmost importance to the process. The advantages of the De Laval *S–N* trichlorethylene method compared with the benzene method include a smaller quantity of solvent used, a shorter period of cooling and the possibility of working at higher temperatures. Particulars were also given regarding acid treatment of petroleum products, and it was concluded that this process had not reached an entirely satisfactory stage. Fundamentally, acid treatment still remains a 'discontinuous process', and suffers from the disadvantages thereof when compared with efficiency of distillation, dewaxing and cracking in continuous plants. The author pointed out directions in which modernisation of acid-refining is desirable and gave an account of the De Laval *S–N* acid sludge separator, which represents a definite advance on anything so far designed. The main importance of this process, however, would seem to be in the field of lubricating oil refining, where it is destined to effect considerable economy in production costs.

Astronomical Topics

Astronomical Notes for January. Mercury can be observed as a morning star early in the month; Venus is also a morning star, but far from the earth, and approaching superior conjunction; its disc is almost fully illuminated. Mars is approaching opposition, and is visible for most of the night; this is an aphelion opposition; the diameter on March 3 will be just under 14″. Jupiter also reaches opposition in March, and will be near Mars for some months. Saturn is in conjunction with the sun in January; Uranus is still observable in the evening. Neptune is well placed for observation in the middle of Leo.

A star of mag. 5·6 is occulted by the moon on Jan. 9, disappearing at 8.28 P.M. κ Geminorum (mag. 3·6) disappears at 10.50 P.M. on Jan. 11, reappearing at 11.24, angle 221°; the moon is full on that day.

The following are the positions of Comet Dodwell-Forbes at the beginning of Jan. 14 and 24, according to the Whipple-Cunningham orbit:

Jan. 14 R.A. $0^h38^m34^s$ S.Decl. 4° 52′; Jan. 24 R.A. $1^h15^m4^s$ N.Decl. 4° 43′.

Comets Faye and Geddes may also be seen with moderate telescopes; there are ephemerides in the B.A.A. Handbook for 1933.

There are minima of Algol at convenient times for observation on Jan. 8 at 7.54 P.M. and on Jan. 28 at 9.42 P.M.; a full table is given in B.A.A. Handbook.

Mass of Eros. Soon after the announcement by W. H. van den Bos and W. S. Finsen that Eros appeared like a figure-of-eight in the 26½ in. Johannesburg refractor in January 1931, Prof. W. H. Pickering derived the mass of Eros on certain assumptions as to its figure. Dr. Knut Lundmark has made a further investigation based on the same material (*Lund. Obs. Circ.*, No. 7). The diameter of Eros was taken as 23·4 km., and it was supposed to consist of two spheres in contact, each having a radius of 5·85 km.; the reciprocal of the mass in terms of the earth is 259,900,000. This gives a density only a quarter of that of the earth. If the distance of centres is increased to 18·6 km., the density becomes equal to that of the earth.

Comets of A.D. 868 and 1366. It was established by Dr. Hind that the second of these comets is in all probability identical with Tempel's Comet, 1866 I, associated with the Leonid meteors; Hind thought that the comet of 868 might also be identical with it. The *Japanese Astronomical Herald* for October, 1932, contains a re-investigation of the orbits of these two comets, by Dr. S. Kanda, based on the original observations; for the first comet he used observations made in Japan, Europe, and Korea; for the second he does not appear to have found any further observations than those used by Dr. Hind, and the new orbit is quite close to that of Hind.

T	868 March 4	1366 Oct. 18·54 U.T.
ω	277°	164·8°
Ω	305	218·5
i	65	149·8
q	0·42	0·9749
e	1·00	0·9059
Period	—	33·35 years (assumed)
Equinox	868·0	1366·0

It may be concluded that the first comet is not identical with Tempel, but that the second probably is identical. This identity had been assumed by the Computing Section of the British Astronomical Association in investigating the perturbations of the comet from 1366 until 1932. Search ephemerides are given in the B.A.A. Handbooks for 1932 and 1933.

Electricity, Gas and Other Fuels as Heating Agents

IN a paper read by Mr. A. H. Barker to the Institution of Electrical Engineers on December 1, an explanation was given of the conditions under which electrical power can be used competitively for the heating of buildings. It is well known that, reckoned on the heat unit basis alone, electricity is the most expensive of all the sources of heat in common use, and that comparatively, gas is at present not very far behind it. Since the heat in a gas company's therm equals 29·4 electric units, it follows that if gas cost 6*d*. per therm and electricity 0·5*d*. per unit, the cost of the crude heat per therm delivered by the gas company would be 6*d*. and by the electric company 14·7*d*. In a few years' time we hope that more companies will be supplying at these cheap rates. If the thermal electric storage were employed the price of the electric heat would be reduced by about forty per cent. With oil at 80*s*. a ton and coke at 40*s*. a ton, the costs would be 2·25*d*. and 1·64*d*. a therm respectively. Looking merely at the costs of the 'crude' heat, the solid fuels are much cheaper.

The most fundamental difference between gas and electric heat is that with the former it is purified fuel which is transported to the spot where the heat is required, while with the latter it is energy only. There are three points arising from this. The street main is much larger and more difficult to accommodate with gas than with electricity but the house-pipes for gas are smaller and cheaper. In order to convert the gas energy into heat, it has to undergo the process of combustion with the disadvantages of high temperature and waste products of combustion. The use of gas causes less actual destruction of fuel than electricity and the heat from it is therefore cheaper. Gas is in fact crude fuel which has had all the ashes and smoke purified out of it at the sacrifice of the manufacturing costs and about twenty per cent of the energy of the crude fuel. Electricity carries the purification a stage further. In its manufacture, everything, including all the labour, is purified out of the fuel but there is a loss of about twenty per cent of the energy in the mains. There are obviously cases, where so far as its usefulness is concerned, this further stage of purification is a pure waste of money, just as it is a waste of money to soften water needed for sanitary fittings.

In Mr. Barker's opinion, gas and electric supply have each their own sphere of usefulness, in which one is either economically or functionally superior to the other. There is only a small area of supply in which reasonable competition is legitimate. Both industries ought to be amalgamated, in their own and in the public interest. It is very difficult to assess the money value of their relative advantages and disadvantages in each particular case.

Apart from its cost, electrical energy is almost an ideal means for room warming. By its agency, pure heat can be delivered through light and flexible wires in any quantity, at any temperature and in any desired form to any particular spot. Turning on and off involves nothing but a mechanical motion of a switch and this can be readily done automatically by a simple and trustworthy form of thermostat. The use of any other fuel gives, along with the heat, products of combustion of a more or less deleterious nature. It is only in very special cases that heat derived from the combustion of fuels can be employed without the use of chimneys.

Gas possesses the advantage that it can be exactly regulated to requirements. It can be conveniently stored so that a sudden overload need not affect the supply. Breakdown is less probable than with the more complicated electrical plant. In some cases when combustion is effected completely, the products are innocuous and so can be allowed to mix with the air of the building and so secure—like the electrical fire—an efficiency of one hundred per cent. The drawbacks are that gas needs to be ignited and supplied with air before the heat can be developed. It has an objectionable smell and is dangerous if it escapes or is incompletely burnt.

The advantages of oil are that it is fluid and so can be pumped with little smell or trouble into a tank through a pipe-line. It is much easier to ignite, to regulate and to extinguish than coke, though more difficult than gas. It is very clean in operation, and when properly burnt highly efficient. Owing to the high degree of the combustibility of oil, there is a good deal of potential danger attached to it. It is apt also to give off smoke and odorous fumes. The advantages and disadvantages of coke and other solid fuels are well known. For example, they will allow any sort of combustible material to be destroyed in the furnace. It is probably the most economical form of heating but it involves greater labour than any other fuel. It produces dust, is dirty to deliver and clumsy to handle.

Mr. Barker deals exclusively with the cost of the fuel and the labour involved in handling it. When the heating required is intermittent, both electrical and gas heating have advantages over the other fuels.

Mesolithic Age in Britain*

IN 1926 the Royal Anthropological Institute held an exhibition illustrating the microlithic industries of Britain, to which all who were then known to be interested and engaged in forming collections of implements of this phase of the Stone Age were asked to contribute. The mesolithic period had been somewhat neglected by British archæologists; and it is probable that it came as a surprise, even in archæological circles, to find how considerable was the amount of material which it had been possible to get together and the increase in the interest taken during the early years following the War in these remarkable products of man's skill and ingenuity.

In the period which has elapsed since that exhibition was held, further progress has been made in the study of the mesolithic age, and the time was fully ripe for a detailed discussion of the position of microlithic industries in relation to preceding and succeeding cultures. The opportunity for such discussion was afforded by a series of papers in the programme of Section H (Anthropology) when the

*Based on certain papers read before Section H (Anthropology) of the British Association at York, September 6, 1932.

British Association met at York last summer. The conditions were exceptionally propitious, as not only were there within reach of York sites of sandy heath typical of the geographical environment preferred by Tardenoisian man, upon which, moreover, numerous finds of implements had been made, but also the fact that Mr. J. G. D. Clark was to open the session with a paper on the mesolithic age in Britain ensured that the otherwise preponderating attention to be given to the north of England in this series of communications would be placed in proper perspective.

The advances which have been made in the study of the typology of mesolithic implements now make it possible to work out the geographical distribution of characteristic forms with a relative certainty, if not with an absolute precision, while a number of pregnant suggestions emerges as to their derivation and development. Thus Mr. Clark holds that, while the Upper Palæolithic industries of Britain already showed microlithic tendencies, the Tardenois culture is to be regarded as intrusive in both its first and second phases, and late Tardenois, though in all probability a local development in its British manifestation—the 'trapezoid' implement is said to be peculiar to Britain—also has indications of continental influence. Thus in the Pennines the 'broad blade' industry, the non-geometric Early Tardenois industry, is certainly of continental derivation, while the Middle Tardenois, which extended as far as the Isle of Man, points to Belgium. At the same time, the view thus taken of late Aurignacian industries must be kept in mind in considering sites which show a sequence of cultures, such as those described by Mr. A. L. Armstrong.

The study of types leads Mr. Clark to divide Britain into two provinces, of which Province *A* is characterised by the absence of the tranchet axe or pick, while the microliths are present both in the early non-geometric forms and in the later geometric forms, some of them of extremely small size. In Province *B*, the south-east of England, on the other hand, the tranchet axe is found, but the place of the geometric forms of Tardenois industry is taken by the still surviving non-geometric forms.

In the working out of the sequence and relation of the phases of Tardenois cultures, the investigations of Mr. F. Buckley in the Pennine chain are especially significant, although the whole chain has not been covered and his conclusions are drawn only from certain selected sites, such as Standedge Ridge, Yorks, where the whole chain narrows down to a single ridge, along which mesolithic man must have passed in avoiding the valleys. Various mesolithic sites under the peat have been excavated. These sites contain the relics of two distinct peoples or races of Tardenois folk. Of these one is known as the folk of the 'broad blade' industry, the other as the people of the 'narrow blade' industry. The implements of the former are predominantly of the non-geometric type and include many pointed blades, while among those of the latter are numerous small geometric tools. This people used open-air encampments and wandered freely over the hills; but the 'broad blade' folk travelled along the watershed ridge and erected huts or wigwams on their camping sites. The hearths have yielded wood remains, giving some data as to tree distribution in mesolithic times.

An important contribution to the discussion of mesolithic problems, comprehensive in its view, was made by Mr. A. L. Armstrong's account of his investigation of the Tardenois and pre-Tardenois cultures of north Lincolnshire in the light of evidence afforded by a number of sites in that area. Here a series of stratified sections and occupied sites exhibits a continuous sequence of industries, embracing the Upper Palæolithic and the whole of the Mesolithic periods. Mr. Armstrong has recently discovered Aurignacian flint implements in glacial gravels at Hardwick Hill, east of the Trent. These are heavily rolled, owing, it is suggested, to the wave action of an estuary or glacial lake, and point to the existence here of palæolithic man before the last glaciation—possibly a band of hunters who had penetrated the swamps and taken up their residence on the dry uplands of the Cliff Range and, probably, also on the Wolds. They appear to have inhabited this region through the last phases of the glacial epoch and to have remained until the appearance of mesolithic peoples, the Azilian and Tardenois. The latter eventually dominated Lincolnshire, according to the indications of a number of stratified sites.

Of these sites the earliest is a late-Developed Aurignacian (Creswellian) station, discovered by Mrs. E. H. Rudkin, and excavated in February last, on the western escarpment of the Lincolnshire cliff above Willoughton. At Sheffield's Hill, near Scunthorpe, a similar occupation site, but of later date, gives evidence of the final phase of the developed Aurignacian, upon which early Tardenoisian was imposed. At Risby Warren, Scunthorpe, where systematic researches have been carried out for eleven years, there is stratified evidence of occupation levels ranging from developed Aurignacian, which is quite free from Tardenois influence, to the earliest neolithic, full neolithic and bronze ages. The Tardenois culture is represented by several horizons and can be classified broadly as early and late. This site, Mr. Armstrong claims, in virtue of its abundance of stratified material and its numerous occupation zones, representing the whole of the Tardenois period, is to be regarded as the type station of Tardenois culture in England.

University and Educational Intelligence

WALES.—The University Court at its meeting on December 15 decided to award the degree of D.Sc. *honoris causa* to Prof. Francis Ernest Lloyd, professor of botany in McGill University, and Prof. Robert Robinson, Waynflete professor of organic chemistry in the University of Oxford.

THE Institute of Sociology, Le Play House, 65 Belgrave Road, London, S.W.1, has now been incorporated as a company limited by guarantee. This is the final step in a scheme for permanently establishing and endowing the Institute, which was initiated in 1920 through the generosity of the late Mr. and Mrs. Branford. Under an order of the Chancery Court, the whole of Mr. Victor Branford's estate, subject to the temporary reservation of a portion for the benefit of relatives, passes to the Institute. The present officers of the Institute are Dr. R. R. Marett (president), Rector of Exeter College, Oxford; Mr. C. H. Rigg (honorary treasurer), and Mr. A. J. Waldegrave (chairman of council).

Calendar of Nature Topics

January freeze-the-pot-by-the-fire

January, the coldest month of the year in England, is proverbially associated with snow and ice. In the French Revolutionary Calendar of 1793, the period from December 21 to January 19 was the month 'Nivôse' or 'snowy'. During the twentieth century, however, January has not lived up to its name, but has been much more open, mild and stormy, with few prolonged frosts. At Greenwich the mean January temperature during the decade 1921–30 was 41·3° F., more than 2° F. above the long-period normal and probably 5° or 6° higher than in some of the decades of the late eighteenth and early nineteenth centuries. This persistent period of mild winters has extended over the whole of western and central Europe; it is associated with a greatly increased frequency of south-westerly winds and may almost be regarded as a change of climate.

Life in the Southern Atlantic Ocean

"January 1—Wilson's petrels, two kinds of prion petrels, albatrosses and a bosun bird were observed to-day. Sun-fish (*Orthagoriscus mola*) were also seen; at 2.30 p.m. a boat was lowered to get one. After several ineffective attempts at harpooning we managed to stun one with shot. Davidson after a while drove the harpoon into the gills, and we then made fast to one of its fins and towed it to the ship. Three or four sucker-fish accompanied it to the boat, and on cutting the sun-fish up, one was discovered in the gills. A parasitic copepod (*Argulus*) was found externally, as well as a polyclad. There was also a parasitic copepod on the gills and a barnacle on the lip. In the intestines numerous tape-worms were found and another leech-like parasite. There was in all probability about 10 lbs. weight of tape-worms in the gut. Its weight by the dynamometer was half a ton. Several others were seen twice as large. Brown saw a globe-fish with a small fish attendant on it. *Salpa* were seen frequently floating past." From "Zoological Log of S.Y. *Scotia*", on January 1, 1903, in lat. 39° 01′ S.; long. 53° 40′ W.

The lethargy of the sun-fish has often been referred to. The individual mentioned above, now exhibited in the Royal Scottish Museum, Edinburgh, was regarded by its captors as a tiny specimen compared with others seen the same day "about the size of a small haystack", and of it they said, "Its stupidity was amazing; unable to swim faster than a boat could row, all it had to do to escape was to sink—and this they can do quite well,—but although struck by a harpoon a dozen times before one held, it made no attempt to escape. . . . When cut up it was easily seen why the first harpoons would not hold, as under the skin was a layer two or three inches thick of a hard cartilaginous material. The dissection was performed mainly with axes. The central nervous system was very interesting on account of its minute size relative to the body, the spinal cord being only about half an inch long and barely coming outside the cranial cavity. This degeneracy is doubtless correlated with the feeble musculature and swimming powers. Intelligence and mobility have become superfluous, the size and thick hide being sufficient protection against most enemies." From "The Voyage of the *Scotia*", by R. N. Rudmose Brown, R. C. Mossman, and J. H. Harvey Pirie.

Hurricanes of the Southern Hemisphere

January 7.—The greatest frequency of hurricanes or revolving storms in the southern hemisphere occurs about the second week in January, though they may be experienced at any time during the southern summer. Four areas are subject to these storms, the islands of Polynesia, especially the Samoa, Fiji and Tonga groups, the Coral Sea between Queensland and the Fiji Islands, the north-west coast of Australia and the South Indian Ocean between the Chagos Archipelago and Madagascar. The Australian storms are locally known as 'Willy-willies', and in addition to causing loss of shipping, frequently result in disastrous floods. The majority of the hurricanes in the southern hemisphere originate between lat. 5° and 15° S., travel at first towards west-south-west, recurve in about 20° S. and finally pass away to the south-east, decreasing rapidly in intensity.

"Furze or Gorse (*Ulex europæus*) flowering"

This record made by Gilbert White at Selborne on January 8 is a reminder of the winter activity of gorse which makes it an important item in the economy of the countryside. The closely cropped conical bushes, which in many places dot a pasture like old-fashioned bee-hives, are evidence of the part it plays in the winter food-supply of rabbits and sheep. Before roots were commonly available for the winter feeding of farm stock, gorse partly took their place: "The sowing of whins for feeding of cattle takes mightily about London just now [1725] . . . this improvement comes from Wales, where it has been practised these hundred years." In Scotland rough whins from waste ground were used in place of the more tender sown crop, and these had to be broken and pulped before being served to the cattle. The apparatus used was a cumbersome whin-mill, the essential part of which consisted of a huge stone roller dragged by an ox or a horse round a paved circuit, upon which the whins were laid. Remains of such whin-mills are still to be seen at occasional farmhouses in Scotland, although whins have long since dropped out of use. In the south of Ireland, however, on hillside farms where hay is scarce, whins are still used for feeding horses during the winter months. The seed is sown on spare ground, and the crop, cut in the following year, is passed through an ordinary chaff-cutter before being served.

The Hibernation of Frogs

In early January 1932, Francis B. Bent (as recorded in the *Observer*, May 1, 1932) emptied a pond and cleaned it out. The pond was ten to fifteen feet deep and the normal depth of water was four feet, but in the clay ooze at the bottom there were discovered thirty or forty frogs. In the same month H. C. Davies (*Field*, May 8, 1932) ran the water out of a small spring-fed pond in order to dig the mud out. In so doing he dug out, not an isolated frog, but dozens. "Their appearance was not attractive—discoloured and skinny—but all alive, though showing very little energy."

Although the older naturalists believed in the hibernation of frogs in winter in the mud of ponds, doubt has recently been thrown upon the possibility

of survival of air-breathing, lung-possessed creatures in such circumstances. However, in the height of the mating season, when activity is not at its lowest, one has seen beneath the clear water of a pond mated frogs remain for long periods inactive on the bottom, and in face of such experiences as are related above it seems probable that in cold weather the lowering of activity in these cold-blooded animals reduces metabolism to so low a pitch that the oxygen required can be obtained by transpiration through the skin. The problem still to be solved in regard to cold-blooded hibernators, as P. A. Gorer has pointed out, lies in the physiological changes which enable the tissues of an adapted animal such as the common frog (*Rana temporaria*) to recover from cooling which is not excessive, while such recovery is impossible in unadapted animals.

Societies and Academies

LONDON

Royal Meteorological Society, Dec. 14. C. S. DURST: "The thermal balance of a water drop or ice particle suspended in the atmosphere." From the examination of the long wave radiation received and given out by a water drop or ice particle, it is shown that such a particle will lose heat if it is above a certain critical temperature and gain heat if it is below, from which it follows that if a particle exists in the stratosphere it will gain heat. It is assumed that the base of the stratosphere is saturated and consideration is given to the conditions under which particles could be formed. If a small air mass were raised in the stratosphere the particles formed in it would be melted in a very short time and the temperature of the air would once more be that of its surroundings, the entropy of the air having been increased in the process.—E. W. BLISS: The tabulation of world weather (5). (Discussion by Sir Gilbert Walker.) (*Mem. Roy. Meteor. Soc.*, **4**, No. 36.) In order to form more definite ideas regarding the oscillations named the North Atlantic, the North Pacific, and the Southern, series of figures have been derived to express the variations of each, and from these have been obtained their relations with pressure, temperature, and rainfall over wide regions as well as the relations of the three oscillations with each other and with sunspots. The southern oscillation in the southern winter is extremely persistent, and its departure has a correlation coefficient of 0·84 with that of the following summer.—C. S. DURST: "The breakdown of steep wind gradients in inversions." On certain occasions when inversions have formed, a violent eddying arises, which is shown on an anemometer as an abrupt change in the type of trace. This change over occurs when the wind gradient becomes great. On the ground that the eddies formed in these circumstances are different in character from those formed with an adiabatic temperature gradient, a suggestion is put forward for the mechanism of the diurnal variation of wind.

DUBLIN

Royal Dublin Society, Nov. 22. J. H. J. POOLE: An investigation of the behaviour of neon discharge tubes in a flashing capacity circuit by means of a cathode ray oscillograph. The effects of leakage currents in the oscillograph were eliminated by using the oscillograph in conjunction with a valve anode resistance amplifier. For small shunting capacities the flashing may be extremely irregular, and quite considerable currents pass through the tube before the flash occurs. The presence of radium lowers the striking potential and, by decreasing the maximum dark current, increases the regularity of flashing. The effect of the shape of the electrodes has also been investigated. For concentric cylindrical electrodes, at the filling pressures used, the difference between the striking and extinction voltages is less when the inner cylinder is negative. H. M. FITZPATRICK: The trees of Ireland, native and introduced. A catalogue of the tree species growing in Ireland giving the dimensions attained by each in different parts of the country with, in the case of exotics, an account of their natural distribution and introduction into cultivation. 150 broad-leaved and 215 coniferous trees are recorded. G. T. PYNE and J. J. RYAN: The colloidal calcium phosphate of milk. Some samples of milk out of a large number tested developed a marked alkalinity to phenolphthalein on addition of oxalate. As the wheys prepared from the same milks did not do so, it appeared that the alkalinity must arise from the interaction of the (potassium) oxalate with the casein calcium phosphate complex of milk, presumably owing to the conversion of insoluble tri-calcium phosphate into the strongly alkaline tri-basic potassium salt. The amounts of tricalcic phosphate required to account for the observed alkalinities approximated to those usually accepted for the entire colloidal phosphate of milk, suggesting that the greater part of this colloid must consist of the tribasic salt. The bulk of the casein calcium phosphate complex was removed by prolonged high speed centrifuging from two very different types of milk (as regards their reaction with oxalate) and submitted to analysis. The results appeared to show that the bulk of the colloid in each case consisted of tricalcium phosphate, and that the variations in the behaviour of different samples to oxalate was thus connected with the relative quantity of the colloid present rather than with variations in its composition.

PARIS

Academy of Sciences: Nov. 14. CH. MAURAIN and J. DEVAUX: Electrical conductivity and atmospheric condensation nuclei during a voyage to Greenland. There is a general resemblance between the electrical conductivity of the air in the polar regions and that on mountains at high altitude, possibly due to the purity of the atmosphere and the dryness. The measurements were too few to enable any deductions to be drawn as to the effects of the meteorological conditions. MARIN MOLLIARD: Aseptic tuberisation and morphological characters resulting from the action of saccharine food on the onion, *Allium cepa*. E. MATHIAS: Death by the return stroke (lightning). J. CANTACUZÈNE and A. TCHEKIRIAN: The presence of vanadium in certain tunicates. Vanadium has been found in nine species of tunicates: the proportion is higher in young animals than in adults. POTRON: The Riemann spaces admitting a group of isometric transformations with $n\,(n+1)/2$ parameters. MARCEL BRELOT: The study of the point singularities of subharmonic functions. PIERRE HUMBERT: Bessel-integral functions. D. POMPEIU: A theorem, analogous with that of Rouché, relative to the zeros of holomorph functions. NICOLAS APRAXINE: A calculating machine worked electrically. B. GALERKIN:

The general solution of the problem of elastic equilibrium of a hollow circular cylinder and of a part of the cylinder. R. DE FLEURY, H. PORTIER and S. BENMAKROUHA: The comparative and reciprocal influences of individual values, for each alloy and for each state of the alloy, of the modulus of elasticity, the elastic limit and the density on the dimensions of beams and elements of framework under bending. LOUIS DE BROGLIE: The electromagnetic field of the light wave. L. GOLDSTEIN: The quantum theory of the diffusion of electrons. ANDRÉ MARCELIN and D. G. DERVICHIAN: The direct measurement of superficial pressure of superficial solutions formed by soluble substances. P. ROUARD: The reflecting power of metals in very thin plates. The reflecting power varies with the thickness of the film, passing through a minimum depending on the wave-length of the light. CH. BEDEL: The temperature coefficient of the electrical resistance of silicon and a thermoelectric phenomenon of unipolar substances. A. SANFOURCHE and B. FOCET: The calcium salt of a complex ferrophosphoric acid. F. GALLAIS: Potassium iodomercurate. LÉON JACQUÉ: The alteration of steels by hydrogen. The modification of the micrographic structure of steel submitted to the action of hydrogen under pressure and at temperatures between 400° and 700° C., appears to be the result of two simultaneous phenomena: the elimination of the carbon of the steel by the hydrogen, and a diffusion of the carbon from the unaltered regions towards the decarbonised regions. The process is a reversed cementation. The change depends on the composition of the steel, chrome-nickel steels, for example, being less altered under the same conditions. M. LESBRE: An imperfect silver-guanidine complex. R. LEVAILLANT: The action of acid chlorides on orthoformic esters. The preparation of symmetrical esters of sulphuric acid. The reaction $CCl_3.COCl + HC(OC_2H_5)_3 = CCl_3.CO_2C_2H_5 + C_2H_5Cl + HCO_2C_2H_5$ gives a 90 per cent yield of the ethyl trichloracetate. The reaction is a general one, and can be extended to the sulphonchlorides. G. DARZENS: A new method of glycidic synthesis of aldehydes. LESPIEAU and WIEMANN: The synthesis of allodulcite. Y. MILON: The antiquity of the depression of the gulf of Morbihan. G. DUBAR and H. TERMIER: The facies of the Lias underlying the Toarcian in the Moroccan middle Atlas. J. GAUZIT: An attempt at the estimation of atmospheric ozone by visual photometry. The method detailed, which has the advantage over other methods in use of taking less time, measures the thickness of the ozone layer in the atmosphere with an uncertainty of less than ten per cent. PH. JOYET-LAVERGNE: Oxidising power, chondriome and cytoplasmic sexualisation in the Fungi. J. BEAUVERIE and MLLE. S. MONCHAL: The life of green plants in a confined atmosphere. Plants contained in glass vessels, with moist earth, and sealed with paraffin wax, can live and grow for several years. Examples are given of plants which have remained in good condition for three or four years thus sealed up. MICHEL GRAČANIN: Contribution to the study of the relation between transpiration and the resorption of ions. MARC SIMONET: New interspecific hybrids in *Iris* and their cytological study. ARMAND DEHORNE: New observations on the asexual multiplication of an annelid of the genus *Dodecaceria*. ETIENNE RABAUD and L. VERRIER: The evacuation of the gases from the air bladder and the working of the pneumatic canal. PAUL WINTREBERT: The two phases of segmentation and the subdivision theory in amphibians.

Forthcoming Events

Monday, Jan. 9

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—B. Roberts: "The Cambridge Expedition to Vatna-Jökull, 1932".

Tuesday, Jan. 10

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Dr. N. Gordon Munro: "The Ainu Bear Ceremony" (Film).

Thursday, Jan. 12

KING'S COLLEGE, LONDON, at 5.—Prof. R. J. S. McDowall: "The Integration of the Circulation" (succeeding lectures on Jan. 19, 26 and Feb. 2).

Official Publications Received

GREAT BRITAIN AND IRELAND

The H.E.A. Year Book: the Annual Publication of the Horticultural Education Association. Vol. 1, 1932. Pp. 92+xl. (Wye: South-Eastern Agricultural College.) 3s. 6d.

County Borough of Southport: Meteorological Department: The Fernley Observatory, Southport. Report, and Results of Observations for the Year 1931. By Joseph Baxendell. Pp. 31. (Southport.)

Brompton Hospital Reports: A Collection of Papers recently published from the Hospital. Vol. 1, 1932. Pp. iv+144. (London.) 2s. 6d.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 8: Recent Views bearing on the Problem of the Irish Flora and Fauna. By Dr. R. Lloyd Praeger. Pp. 125–145. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

True Temperance Scientific Committee. Monograph No. 8: In Chase of Truth of Alcohol. By Prof. Henry E. Armstrong. Pp. 32. (London: Donington House.) 1s.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 30: A Suggested Mode of Radiotherapy when Long-continued Feeble Gamma Radiation may be Desirable. By Dr. J. Joly. P. 469. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

OTHER COUNTRIES

International Hydrographic Bureau. Report of the Proceedings of the Third International Hydrographic Conference held at Monaco, 12–23 April, 1932. Pp. 435. (Monte Carlo.) 2.50 dollars.

Colony of Mauritius. Annual Report on the Royal Alfred Observatory for the Year 1930. Pp. 4. (Mauritius.)

Miscellaneous Publications of the Royal Alfred Observatory. No. 11: Pilot Balloon Observations at Mauritius. By R. A. Watson and N. R. McCurdy. Pp. 17+3 plates. No. 12: The Cyclone Season 1929–1930 at Mauritius. By R. A. Watson and N. R. McCurdy. Pp. 3+43 plates. (Mauritius.)

Indian Central Cotton Committee: Technological Laboratory, Technological Bulletin, Series A, No. 22: Technological Report on Banilla Cotton, 1930–32. By Dr. Nazir Ahmad. Pp. ii+17. (Bombay: *Times of India* Press.) 8 annas.

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Vol. 4, No. 1, August. Pp. 27. (Calcutta.) 6 rupees.

Paleontologiese Navorsing van die Nasionale Museum. Deel 2, Stuk 5: Voorlopige Besbrywing van Vrystaatse Soogdiere. By Dr. Ir. E. C. N. Van Hoepen. Pp. 63–66. (Bloemfontein.)

Publications of the Observatory of the University of Michigan. Vol. 5, No. 2: The Orbit of Comet Peltier-Whipple, Second Paper. By Allan D. Maxwell. Pp. 4. (Ann Arbor, Mich.)

U.S. Department of the Interior: Geological Survey. Professional Paper 166: Physiography and Quaternary Geology of the San Juan Mountains, Colorado. By Wallace W. Atwood and Kirtley F. Mather. Pp. vi+176+34 plates. Professional Paper 167: Lower Triassic Ammonoids of North America. By James Perrin Smith. Pp. v+190+81 plates. 70 cents. Professional Paper 171: Geology and Ore Deposits of the Pioche District, Nevada. By Lewis G. Westgate and Adolph Knopf. Pp. viii+79+8 plates. 85 cents. Professional Paper 173: Geology and Ore Deposits of the Stockton and Fairfield Quadrangles, Utah. By James Gilluly. Pp. vi+171+32 plates. (Washington, D.C.: Government Printing Office.)

CATALOGUES, ETC.

The Protexray Tube. Pp. 32. (London: Cuthbert Andrews.)

F/2 Spectrograph. (Lispec 33.) Pp. 4. Vacuum Thermocouples for Measuring Weak Alternating Currents. (Brug 31.) Pp. 2. (Delft: P. J. Kipp en Zonen.)

Calendar for 1933. (London: The *Chemical Trade Journal*.)

John G. Stein and Co., Ltd. Diary for 1933. Pp. 64+Diary. (Bonnybridge.)

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